

KENYA COLONY AND PROTECTORATE



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VOLUME II

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(Note.—In Volume I of this Report it was stated that the Annual Report of the Senior Coffee Officer would appear in this Volume, but it has since been found desirable to publish it in the *East African Agricultural Journal*. It will appear in the November, 1936, number of the Journal).

Annual Report of the Department of Agriculture, 1935

VOLUME II

PLANT INDUSTRY

Part I.—Botanical Section

REPORT OF THE SENIOR PLANT PATHOLOGIST

STAFF.

The senior staff of the section were on duty throughout the year.

Mr. D. C. Edwards, Agricultural Officer in Charge of Grassland Improvement, had his headquarters at the Veterinary Research Laboratory, Kabete, while Mr. C. A. Thorold, Mycologist, was stationed on Mount Elgon, where he was principally engaged in investigations on "Elgon dieback" of coffee. He also worked on coffee berry disease and certain diseases of cereals.

In the early months of the year the Coffee Berry Disease Experimental Station, Sotik, was under the local direction of Mr. H. Wilkinson, seconded from the Entomological Section, but on his return to duty with his own section I resumed direct control of the station, with a Plant Inspector (first Mr. A. J. Cooper and later, on his return from leave, Mr. E. Cottington) in charge of operations in Sotik.

Mr. F. W. Evans, Junior Laboratory Assistant, was absent on leave from 31st January till 20th October.

LECTURES, SHOWS, AND FARMERS' DAYS.

Mr. Thorold attended Farmers' Days at Kitale and Eldoret in February, and a Field Day at the Departmental Plots, Kitale, in October. He was also present at general and committee meetings of the Trans Nzoia Coffee Planters' Association on four occasions.

I addressed a meeting of farmers in Sotik in February, and Mr. Edwards addressed one at Thomson's Falls in August.

At the Nairobi Show in July, Mr. Edwards prepared the section of the Departmental soil erosion exhibit which dealt with erosion in grassland, while I staged an exhibit of coffee diseases in conjunction with the Coffee Section.

INVESTIGATIONAL WORK.

Mr. Edwards's report on his work on grassland improvement will, as usual, be submitted separately.

Coffee.

Berry Disease.

At the Coffee Berry Disease Experimental Station in Sotik resistance studies have continued to be given the principal consideration.

Eleven different varieties or selections have now been planted for future observations on their degree of resistance to berry disease and their cropping qualities under Sotik conditions. About half a dozen of the earliest planted of these began to come into bearing in 1935. Some of the same varieties are being grown for similar observations on Nandi Escarpment and Mount Elgon. On a plantation in the former area, a few trees of the Harar variety, which are probably the oldest in any berry disease district, show a robust type of growth which inspires the hope that they may also possess disease-resistant qualities. The trees are five years old from seed (about three years from planting), and have produced a fly crop of promising appearance.

The supposed breakdown in resistance to berry disease of Blue Mountain coffee in Kipkarren district was investigated by the Senior Coffee Officer during the year. He found that "the area in question was freely mixed with Mocha and other types of varying ages". It has since been ascertained that the seed from which this coffee was grown was not directly imported, but of Kenya origin. In view of the fact that at the time of the originally reported "breakdown" in resistance, the intensity of infection in neighbouring Mocha coffee was estimated to be fifty per cent, the ten per cent infection said to occur in the so-called Blue Mountain block is readily explained on the basis of the considerable mixture of other types present. I am satisfied, as the result of six years' observations, that pure, directly imported Blue Mountain coffee is highly resistant to berry disease.

Mr. Thorold, as will be seen from extracts from his report given below, is combining observations on resistance to

Elgon dieback and berry disease. This has been made possible by the fortunate circumstance that he is stationed on a farm where both diseases exist.

Vegetative propagation work, designed to discover combinations of scion and rootstock suited to local conditions and resistant to berry disease, has made good progress at the Sotik Station.

Coffee grafts made each month have continued to be highly successful, and it seems probable that they can be produced at any time of the year under Sotik conditions. Grafted plots in the field up to now have had of necessity to be mainly confined to those which could be made by using suckers from cut-back trees of the susceptible Mocha type already long-established on the plots when the station was inaugurated. Various kinds of scions, including some of resistant or supposed resistant varieties, have been grafted on to such susceptible rootstocks. In this way uniform plots of each of the following combinations have now been established :—

Blue Mountain (from directly imported seed) on Mocha root-stocks.

Blue Mountain (from local seed) on Mocha root-stocks.

Kent's Arabica on Mocha root-stocks.

Harar on Mocha root-stocks.

Intervening control blocks, in which the suckers from the stumped coffee are being allowed to grow normally, without grafting, have been left for future comparison.

In order to test the possible effect of root-stocks of resistant type on susceptible scions, small blocks of young Blue Mountain coffee have been granted with scions selected from known susceptible bushes among the ordinary Mocha coffee growing on the station.

Plots have also been established in which seedlings of Blue Mountain, Kent's Arabica and Harar have been inarched into verticals of multiple-stem Mocha coffee stumped at one foot. In another plot a rather different method, namely, approach grafting between Blue Mountain seedlings and Mocha suckers of similar size, has been employed. All these combinations have been readily effected.

As increasing supplies of seedlings of reputedly resistant types become available, it is intended to press forward the

production of combinations between these used as root-stocks and scions from high-yielding types, to be planted out as soon as possible for field trials.

Among the general experiments carried out, there is one which has somewhat revived interest in the possibilities of spraying for the control of berry disease. A test was made of good cultural methods combined with applications of one per cent Bordeaux mixture at particular times (namely, January and July), based on the practice at an estate on Nandi Escarpment, where good control of berry disease is claimed. The infection in the sprayed plots of multiple and single stem coffee was 4.3 and 9.1 per cent respectively, compared with 14.0 and 25.8 per cent for the unsprayed controls, the reduction in each instance being to about one-third. A number of bushes in these plots, marked early in the season as of "resistant type", eventually showed average infection of about 3 and 6 per cent in the sprayed and unsprayed portions respectively, but were undoubtedly considerably lower yielders than the rest.

Plots which have been sprayed annually with half per cent Bordeaux mixture, in March and July, since the Station was started in 1932, last season showed 11.2 and 13.6 per cent infection in the sprayed multiple-stem and single-stem coffee respectively, compared with 22.4 and 31.9 per cent in the controls.

Experiments in which stripping a proportion of the crop was carried out showed that some control of berry disease could be effected in this way. The reduction in harvested crop from stripping, however, was much greater than that from disease.

Stripping all crop except that arising from the short rains flowering (October, 1934) failed to reduce the amount of disease significantly. Where only the crop from the long rains flowering, 1935, was allowed to mature, berry disease was reduced to about one per cent compared with nearly twenty per cent in the control, where all crop was allowed to mature. This, however, may have been due to the fact that similar attempts to limit crop to that from long rains flowerings in the two previous years resulted in the production of no crop at all. The enforced rest may therefore have conferred some temporary resistance on the bushes in the treated portions. In any case, however, the amount of crop harvested from the restricted flowerings, both long and short rains, was much less than that from the unrestricted controls.

In separate experiments designed to test the effect of zinc on the incidence of berry disease, applications of zinc sulphate were made both in the form of a spray and as soil dressings. No reduction was effected where the spray was used. Owing to lack of crop both in the treated and control plots, no observations were possible in 1935 on the effect of the soil dressings.

Elgon Dieback.

Mr. Thorold has continued his investigations on this disease throughout the year. In addition to his work on the Kenya side of Mount Elgon, he was able, through the courtesy of the Hon. Director of Agriculture, Uganda, to visit the coffee growing at altitudes of 5,000 to 7,000 feet on the Uganda slopes of the mountain, in the Bugishu district, and to compare it with that growing at similar altitudes on this side. Much information of interest and value was thus obtained. Special thanks are due to Mr. A. J. Kerr, Agricultural Officer in charge of the Bugishu Coffee Scheme, who arranged the details of Mr. Thorold's tour.

By unsuccessful attempts to produce Elgon dieback by inoculation with various fungi and by proving that the amount of the disease present is unaffected by removal of diseased branches, Mr. Thorold has obtained strong evidence that Elgon dieback is essentially a physiological disease. He has also found that adequate shade has a considerable controlling influence on the disease and that a variety or type of coffee exists which is highly resistant to or immune from it.

The following is an extract from Mr. Thorold's own report :—

“ The data now obtained for the occurrence of Elgon dieback during a twelve-months' period have clearly shown that there are times of the year which are 'peaks' for the prevalence of the disease. In the period December, 1934, to January, 1936, the peaks have been in July and October-November, whilst a comparatively negligible amount of Elgon dieback was present in the period January-March. It seems probable from this extreme seasonal occurrence of the disease that climatic differences are responsible, especially since it is known that shade also reduces the amount of the disease. Now that one is in possession of these facts it should be possible to find some common factor in the conditions resulting from overhead shade as opposed to no shade, and in the weather of seasons when the disease is at its maximum contrasted with months when little or no dieback occurs. So far, the particular climatic elements com-

posing this 'common factor' have not been established. It is proposed that the problem should be attacked from the other direction of subjecting susceptible plants to known and controlled conditions. Until the disease symptoms can be reproduced by some such experimental procedure as regulated temperature changes, any theory as to the cause of Elgon dieback must be purely hypothetical. Until the cause is known, any recommendations for control must be advanced with caution and reluctance. Such control measures will be empirical and suspect at that."

In order to obtain precise information on the effects of shade on coffee in an Elgon dieback area, an experiment under artificial shade has been started. This has only been possible through the co-operation of Mr. T. H. E. Jackson, whose interest and whole-hearted assistance throughout the work have been of the greatest value. Careful records of the amount of dieback present since December, 1934, and of the yields of all the individual trees included under the artificial shade had been taken for two cropping seasons before the erection of the shade, to serve as a basis for future comparisons. During the course of the experiment, measurements will be made of root, shoot, and leaf growth on trees, with and without the shade, and contemporaneous meteorological observations will be kept.

Observations are being made on established coffee growing under the shade of old "Msembe" (*Entada abyssinica*) trees, which grow wild in the district. Mr. Thorold says of this tree :—

" Compared with other shade trees, coffee always looks well under *Entada* shade. In fact, this tree is almost ideal for the district, were it not for the fact that it is said to be very slow growing. At the same time, it has the advantage of being truly permanent and evidently long-lived. It has a natural flat-topped canopy type of growth, and so does not require pruning into a desirable shape, and further than that it does not seem liable to breakage of limbs and branches as in the case of some shade trees. Although *Entada* somewhat resembles a 'thorn' (*Acacia*) tree in appearance and feathery leaves, it is not a surface feeder, and has a deep taproot which does not rob the adjacent coffee trees as happens in the case of 'thorn' trees as shade."

With the generous assistance and co-operation of Mr. R. Anderson, a tree shade experiment has been laid down, in which plots of *Entada abyssinica*, *Acrocarpus fraxinifolius*,

Grevillea robusta, *Ficus sycomorus*, and *Albizzia lophantha* have been established in a block of coffee in an area subject to Elgon dieback.

On the subject of resistant types, Mr. Thorold states :—

“ On account of the expense involved in erecting artificial shade, and in consideration of the doubts and difficulties associated with tree shade, it is probable that a variety of coffee which is resistant to Elgon dieback would best meet, at least the immediate needs, of farms suffering from Elgon dieback. The routine observations on the presence of Elgon dieback on approximately three hundred trees at Kapretwa have enabled me to distinguish a few immune or highly resistant trees, and some relatively resistant, and the no less valuable determination of the highly susceptible trees. It is also possible to distinguish the types as consistent in their relative resistance and susceptibility. The immune trees are all of the so-called ‘Series A’ type; that is, corresponding to the type from which Series A was selected by Mr. A. D. le P. Trench, Senior Coffee Officer. This type has the disadvantage of bearing a large proportion of misshapen and ‘elephant’ beans. I am studying a large number of individual trees, representative of this type, in the hope of finding some which are more desirable than the generality of the type. Certain of the trees in this type unfortunately suffer severely from coffee berry disease and brown blight. It is evident that since certain farms are liable to both Elgon dieback and berry disease, it would be unwise to put too much reliance on planting only Elgon dieback immune trees. It is fortunate that the Blue Mountain variety appears from preliminary observations to be resistant to coffee berry disease and relatively resistant to Elgon dieback. In order to gain the necessary information on the disease-resistance of Blue Mountain coffee, observations have been commenced in a field of this variety at Kapretwa. The yields have been recorded of fifty Blue Mountain trees, and it is intended that these records should be continued in subsequent years. At the same time, observations on the presence of diseases, both Elgon dieback and berry disease, will be maintained.

“ In the hopes of finding some quicker method for renovating a *shamba* which is affected by Elgon dieback, I have been investigating the possibilities of grafting methods. I have now established in the field a number of examples of resistant type scions grafted on to susceptible trees as root-stocks. It will be possible to observe these trees during 1936, as to whether the scion shoots remain free from Elgon

dieback, in comparison with sucker shoots from the root-stock. If immunity to disease is retained by the grafts, then immediate steps will be taken towards simplifying and extending the grafting technique for application on a large scale. Excellent union and growth have been obtained with both cleft and crown grafting on to suckers. I have also established numerous 'approach grafts', where a seedling is inarched on to suckers of various sizes. It is possible that a method of approach grafting may be usefully applied on a field scale.

" The propagation of varieties by grafting has been utilized for the accumulation of a great number of varieties and types of coffee collected elsewhere and now established at Kapretwa. It is obviously a great advantage to be able to compare a number of such selections in close proximity. These include material obtained from immune or resistant trees growing on other farms in the neighbourhood, whilst there are trees on two farms in the vicinity which are reputed to have been free from berry disease, compared with other trees, over a number of years. Scions from these resistant trees have been successfully grafted on to trees at Kapretwa for observation in a part of the farm where berry disease is usually present."

Wheat.

Stem Rust.

A great deal of work was done in connection with this disease during the year.

The production of an artificial rust epidemic in the field was supervised at the Scott Agricultural Laboratories. This was carried out to subject new hybrid wheat selections to severe infection with different physiologic forms of rust in order to test their resistance to the disease. The epidemic was brought about on much the same lines as those described in my last year's report, except that much greater reliance was placed on the injection method of infecting the surround rows. This proved highly satisfactory.

A considerable number of new hybrid selections were tested by artificial inoculation in the seedling stage, to determine their likely rust resistance to one or more of the four physiologic forms which exist in Kenya.

A much larger number than usual of tests of rust samples received from various districts was made to determine the form of rust present and to discover any new forms which might

have appeared. In several instances, two or more forms were present in the same sample, and had to be separated by laboratory means before their presence could be definitely recognized. The work involved required over seventy experimental tests, each of a month's duration. No new form was definitely discovered, although at the very end of the year one was suspected and further investigations were proceeding. Form K4 was by far the most prevalent, and was responsible for much the most damage to wheat crops in 1935.

A single sample of rust received from Subukia in July proved to contain three of the four Kenya forms, namely, K2, K3, and K4. Six samples of rust on Equator wheat from four different districts, namely, Mau, Burnt Forest, Plateau and Sergoit, received in October, November and December, all contained both forms K2 and K4. Rust on certain other varieties, received from three of these districts at the same time as the Equator samples, disclosed only the presence of form K4. The following list, compiled as the result of laboratory tests, indicates the distribution and relative prevalence of the four forms during the year:—

K1.

Endebess—August.

K2.

Subukia—July.

Njoro—August.

Sergoit—October.

Mau—October, November, December.

K3.

Nairobi—July.

Subukia—July.

Thomson's Falls (?)—November.

K4.

Elgon—January.

Nairobi—January and June.

Kiu—June.

Kijabe—June.

Nairobi—July.

Subukia—July.

T'imaui—October.

Mau—October.

Kapenguria—October.
Burnt Forest—October.
Plateau—October.
Sergoit—October.
Timau—November.
Mau—November.
Burnt Forest—November.
Kipkabus—November.
Londiani—November.
Molo—November.
Thomson's Falls—November.
Mau—December.

Two samples of stem rust from the Belgian Congo and one from Arusha, Tanganyika Territory, all proved to be no longer viable on arrival.

A small amount of stem rust on a specimen of rye received from Njoro in October was found to be one of the wheat-attacking strains, namely form K4. Under test at the laboratories, it readily infected wheat seedlings of varieties known to be susceptible to that form, but practically no infection could be induced on rye.

Yellow Rust.

At several sites, including his high-altitude cage at 11,000 feet on Mount Elgon, Mr. Thorold planted the wheat varieties used as differential hosts for distinguishing between different forms of yellow rust (*Puccinia glumarum*), but no yellow rust appeared. In connection with this work Mr. Thorold has had a similar experience to my own with orange rust (*Puccinia triticina*). Great difficulty has been found in maintaining a supply of seed of some of the differential hosts, a number of which are winter wheats. This has been one of the principal reasons for carrying out the vernalization experiments mentioned below.

Take-all.

The following is extracted from Mr. Thorold's report on this disease :—

“ The work involved in tending and maintaining the Take-all experiment at Molo has been carried out for me by Mr. R. S. Ball, Agricultural Officer, and certain other experiments on this disease in Molo are also in his charge.

I have ascertained during the year that Take-all also occurs on Mount Elgon, although fortunately it is not yet as severe or extensive here as in the Mau-Molo area. I have started an experiment in the field which is intended to be comparable and complementary to that at Messrs. Sayers Brothers' farm, Molo. A small plot at Kapretwa was planted with wheat and later an attempt was made to inoculate the soil and crop with *Ophiobolus graminis* . . . The object of the experiment is to obtain as soon as possible a severe localized infection of Take-all under natural conditions in the field. If the inoculation is successful at Kapretwa, it is proposed that several indigenous grass species shall be planted in small strips on this plot. After the grasses have been maintained for a few years they will be turned in and wheat planted on this plot. It should be possible then to determine from the reappearance of Take-all in parts of the plot which of the grass species has acted as a host and maintained the fungus in the soil during the period when wheat was not present.

Fusarium Root Rots.

Mr. Thorold gives the following account of an experiment with wheat under this heading :—

“ A small experiment was carried out in the field at Kapretwa to determine the relative virulence of *Gibberella saubinetii* and *Fusarium moniliforme* var. *subglutinans* as parasites of wheat. The method of inoculation was to use maize grains from ears typically representative of pink ear rot (*G. saubinetii*) and of blue ear rot (*F. moniliforme*). These grains were chosen such that they were so severely rotted that they would not germinate but merely act as a piece of inoculum material of the fungus in question. It was realized that this could not be expected to represent a pure culture of either of these fungi, but it was thought that it might have the advantage of being a more ‘natural’ form of inoculum than that which is the case when any culture medium is added to the soil in the usual procedure of soil inoculation. There was no apparent difference in the inoculated rows of wheat compared with two controls, which were sterile maize grains in one case and no inoculum material added to the soil in the other. This experiment tends to show, as was already believed, that under favourable growing conditions for wheat neither *Gibberella saubinetii* nor *Fusarium moniliforme* can be considered as pathogenic to wheat. This is not to say that under unsuitable conditions for the host, these fungi cannot contribute towards a root-rotting which may result in crop losses.”

Vernalization.

Owing to the difficulty experienced in maintaining seed supplies of certain varieties of very long growing period, required for wheat rust work (*see above*), an experiment was carried out to try to induce earlier maturation by means of vernalization. The process consists in effect of inducing the earliest stages of germination by soaking the seed and then exposing it to a temperature just above freezing point for a given period. The method followed was that of Peltier and Kiesselbach ("Inducing Early Fruiting in Winter Wheat," *Journal of the American Society of Agronomy*, 26, 6, p. 503), and the wheat varieties used were Mediterranean and Hussar. Four batches of seed of each of these, each consisting of 25 seeds, were planted on 3-11-34 after having just previously been exposed to the low temperature for 52, 49, 30 and 15 days respectively. Similar but untreated rows of each variety were planted at the same time, as controls.

The first head to appear was a single one of Hussar on 8-8-35 in the 49-day batch. It was very poor in appearance, and failed to mature any grain. No further heads were noted until 28-10-35 when one had emerged in the 52-day Hussar batch and four in the Hussar control rows. At this time three heads were visible in the 30-day Mediterranean batch, and several other plants were piping in these rows and in the control rows of this variety. Eventually, on 28-11-35, the only seed harvested was from five heads in the 30-day Mediterranean batch and from four in the control of this variety. No Hussar seed reached maturity. The experiment thus failed in its object, but the results are in keeping with those obtained by other officers in similar investigations carried out in Kenya.

Seedling Disease.

Cases of seedling disease which were troublesome in laboratory plots of the variety B.68.E.12.A.1.(L) at Nairobi in May proved, on investigation, to be due to *Helminthosporium sativum* P.K. and B.

*Maize.**Head Smut.*

The following is taken from Mr. Thorold's report :—

"A limited amount of investigational work has been carried out on maize diseases during 1935. I carried out inspections in the field and instituted inquiries with the Agricultural Officer concerning a somewhat severe outbreak of Head Smut (*Sorosporium reilianum* (Kuehn) McAlp.) in

the Trans Nzoia. Considering the large acreage of maize in this district it is remarkable how little damage is usually done by head smut. It was considered that the outbreak in this year was to be traced to the lack of early rains between harvest and planting, which resulted in an unusual amount of spores being present in a viable condition in the soil when the crop was planted."

Ear Rot.

In connection with the advice given by the Department to select for seed maize ears having bright pith only, interesting results were obtained in a small test carried out during maize selection at the laboratories.

Two maize ears, which appeared completely free from blemish, except that one had a slightly dull pith, were used in a germination test for which one hundred seeds were selected at random from each. The following number of seeds germinated from the two ears in the time stated :—

Days				Bright Pith	Dull Pith
4	..	..	..	55	38
5	..	..	..	88	59
6	..	..	..	98	87
7	..	..	..	—	97
8	..	..	..	—	99

Thus, although one more seed eventually germinated in the batch from the ear with a dull core, the seed from the other ear showed much greater vigour. Furthermore, over half of the former developed in the germinator the dark purple discoloration due to the presence of the ear rot fungus, *Fusarium moniliforme* Sheld., whereas the seed from the ear with the bright pith was almost entirely free from the fungus.

Sorghum.

Grain Smut.

Tests with two proprietary preparations, Agrosan G and Abavit B, as dust treatments for the control of grain smut (*Sphacelotheca sorghi* (Lk.) Clinton), were carried out at my request by the Agricultural Officer, Machakos (Mr. R. E. T. Hobbs), whose assistance I gratefully acknowledge.

In calculating the results obtained, allowance had to be made for the presence of head smut (*Sorosporium reilianum* (Kuehn) McAlp.), which is not considered to be amenable to

seed treatment. The figures given are, however, believed to be a fairly accurate representation of the control of grain smut which was achieved :—

Control : Seed untreated.—26.4 per cent infection in resulting crop.

Seed treated with Agrosan G.—1.2 per cent infection in resulting crop.

Seed treated with Abavit B.—2.1 per cent infection in resulting crop.

Linseed.

Wilt.

Some attention has been paid to a disease of Morocco linseed which caused trouble at the Plant Breeding Station during the 1935 season.

Cultures made from affected plants produced one or more species of *Fusarium*, and another fungus, *Rhizoctonia bataticola* (Strain C of Haigh), which has been recorded as a root parasite of doubtful importance on a number of host plants elsewhere. Inoculation experiments with the various *Fusarium* cultures and this *Rhizoctonia* completely failed to cause infection, but during the course of these and other experiments, where in certain instances plants were raised from untreated seed obtained from Njoro, numerous cases of seedling disease occurred. Cultures from these plants almost invariably yielded a different species of *Rhizoctonia*, believed to be *R. solani* Kuehn. This in further inoculation experiments proved very virulent, and under the conditions of the experiments caused the death of large proportions of inoculated seedlings.

Investigations of the disease are still proceeding, and attempts to find satisfactory control measures are being made.

Lilies.

Mosaic.

In September a visit was paid to a farm near Nairobi where various varieties of lilies are grown on a commercial scale. Large numbers of the blossoms, especially of *Lilium philippinensis*, but also to some extent of *L. Harrisii*, showed splitting and failure to open, while many plants of the former were dwarfed. Virus disease was suspected but, except in isolated instances among the latter variety, mosaic symptoms could not be found. A number of specimens were collected and transplanted at the laboratories for further observation. During the course of the next few months most of the original

plants suspected of being infected with virus disease died out, in some instances after producing aborted flowers. From the base of some of the *L. philippinensis*, however, young plants arose. These grew slowly, showed contortion of the apical leaves, and developed most marked mosaic symptoms, thus dispelling all doubt as to their being infected with virus. It was very noticeable that the only original plants which developed normal flowers and seeds were those from which young plants subsequently arose which were free from mosaic symptoms. As far as could be judged, the disease appeared to belong to the third type of mosaic described by Ogilvie and Guterman ("A Mosaic Disease of the Easter Lily," *Phytopathology*, 19, 3, 1929). Aphids were found on one of the affected plants, and were sent to London for determination.

NEW PLANT DISEASE RECORDS.

The only diseases of comparative importance newly recorded during the year were peppermint rust, which causes considerable defoliation both of English and Japanese peppermint, and mosaic disease of lilies, which has caused some loss to a commercial grower. The list of new records for 1935 is as follows:—

- Banana.—Anthracnose of fruits, *Gloeosporium musarum* Cooke and Massee.
- Groundnut.—From roots, *Rhizoctonia bataticola* (Taub.) Butler (C Strain of Haigh).
- Linseed.—From roots, *Rhizoctonia bataticola* (Taub.) Butler (C Strain of Haigh).
- Peppermint (*Mentha piperita* L. and *M. arvensis* Holmes, var. *piperascens*).—Rust, *Puccinia menthae* Pers.
- Cucumber.—Scab, *Cladosporium cucumerinum* Ell. and Arth.; Downy mildew, *Peronoplasmopara cubensis* (B. and C.) Clint.
- Rye.—Stem rust, *Puccinia graminis* Pers.
- Lily (*Lilium philippinensis* and *L. Harrisii*).—Mosaic; Virus.

ACKNOWLEDGMENTS.

I have to record my thanks for valuable assistance received as usual from the Directors and staffs of the Royal Botanic Gardens and the Imperial Mycological Institute, Kew.

J. McDONALD,
Senior Plant Pathologist.

REPORT OF THE AGRICULTURAL OFFICER IN CHARGE OF GRASSLAND IMPROVEMENT

The work in progress bears upon the problems of the three main climatic types of grassland which were described in the Report for 1934, that is, the areas of comparatively high moisture and low temperature, the intermediate areas, and the drier areas. Apart from the essentially different problems presented by these types of grassland, the requirements under European farming conditions are often widely different from those of the areas under native occupation.

Briefly stated, the main lines of progress at which the work aims are as follows :—

(a) *Areas of European Settlement.*—In the high altitude regions, the development of intensive management by the production and maintenance of Kikuyu grass (*Pennisetum clandestinum* Hochst.) and indigenous clover pastures; in the areas of intermediate climatic conditions, intensive management by utilization of the natural herbage and the establishment of sown down pastures; and in the drier areas, where intensive management of grazing is out of the question, first and foremost the conservation of fodder for use in the periods of scarcity, and secondly the control of grazing on extensive lines to prevent deterioration.

(b) *Areas of Native Occupation.*—In the moist high-altitude regions and the areas of comparatively high rainfall at lower altitudes, the requirements of native grassland management are essentially similar to those of the European areas. With the progress of mixed farming amongst the agricultural tribes which occupy these areas, intensive grazing methods will become increasingly necessary. Vast drier areas of the country are occupied by the pastoral tribes, and in these parts the main requirement is the control of grazing on extensive lines by the application of a comprehensive plan, compatible with the nomadic habits of the tribes concerned.

The importance of development in the direction of conservation of fodder for use in the dry periods of the year can scarcely be over-estimated. In both the European farming areas and the more densely populated native areas, the storage of the surplus grass of the growing season, and the provision of crops for silage under European farming and as a reserve for feeding green under native conditions, must form an essential part of the development of intensive management. Considerable advance in this direction has been made in the

European areas recently, but there is still far too great a tendency to rely on the pasture as the main and often the sole source of food for the stock throughout the year.

PROGRESS OF THE WORK AT THE CENTRAL GRASSLAND STATION AT KABETE.

The main experimental work is situated at the Veterinary Research Laboratory, at an altitude of 6,200 feet and under an average annual rainfall of 41.94 inches. The area was originally covered by forest, the remnants of which are chiefly represented by a *Ficus* species and *Albizzia fastigiata* E. Mey. The herbage over practically the whole of the farm consists of *Pennisetum clandestinum*, with varying proportions of *Trifolium Johnstonii* Oliv. (indigenous clover), although there are indications that where the soil fertility has fallen to some extent other grass species are tending to replace the *P. clandestinum*. The above climatic conditions are not quite typical of the areas of high moisture and low temperature described in the 1934 Annual Report, and the conditions of Kabete can be considered transitional between these areas and those of intermediate conditions.

The work at this station therefore bears chiefly upon the problems of the high altitude and intermediate conditions of the country.

The main part of this work was started in 1934, and time has so far been devoted chiefly to the establishment of the experimental plots. During this period upwards of one hundred species have been given a preliminary trial under nursery conditions, and of those which were considered sufficiently promising for more extensive trials some forty species have been successfully established under field conditions.

High Altitude (Kikuyu Grass) Areas.

Intensity of Grazing Experiment.—Natural Kikuyu grass pasture has been subjected to different amounts of grazing. The treatments have now been completed, and it is hoped to report the results at an early date.

Manurial Experiments.—An experiment has been undertaken in collaboration with the Soil Chemist. It is of a preliminary nature, and is intended to indicate the effects of mineral fertilizers and farmyard manure on the yield and botanical composition of natural Kikuyu grass herbage. The visible results to date can be summarized as follows: Farmyard

manure applied at the rate of 20 tons per acre has produced a definitely greater bulk of herbage. The plots receiving ammonium sulphate have been visible each season by the darker green colour of the herbage, but no marked increase in yield has been observed. The dressings of super-rock phosphate have resulted in temporary increases in the proportion of indigenous clover (*Trifolium Johnstonii*), particularly where this manure was combined with potassium sulphate. No further results are evident from an examination of the plots, but it is clear that an investigation, primarily of a chemical nature, should be made of the degree to which the herbage is capable of absorbing the minerals applied, particularly as it is known that, in general, calcium and phosphorus are deficient, and that these elements will almost certainly have to be applied in connection with any intensive grazing methods which may be adopted.

A further manurial experiment was established during the year on heavily grazed Kikuyu grass pasture, with a view to investigating the possible indirect effect upon yield, of phosphatic manure, by stimulation of the clover, as against the direct effect of nitrogenous manure.

Kikuyu Grass Strains.—With the object of finding possible strains of this grass, material was obtained from various isolated climatic areas of the country in which it occurs. Three types distinctly different in appearance have been observed, and an experiment has been established for the purpose of comparing these.

Indigenous Clover (Trifolium Johnstonii) Strains.—Three types of this clover have been obtained locally at Kabete, and the material is being increased in order to compare these types.

Hay Production.—An acre plot is sown with Rhodes grass (*Chloris gayana* Kunth.) and seven different legumes. Most of these can already be eliminated for hay production with this grass. One of the most promising types is the indigenous *Indigofera tettensis* Klotzsch, obtained from the Machakos area. A number of further trials are in progress in which various mixtures of this grass and *Amphilophis pertusa* Stapf. with *Lespedeza* species and lucerne are being used.

Intermediate Areas.

Apart from the preliminary trials under nursery and field conditions already mentioned, the following experiments on pasture and fodder plants have been established at Kabete.

A Series of Ten One-tenth-acre Grazing Plots.—These plots of pure species have now been successfully established, and it is intended to compare the behaviour of the different grasses under grazing conditions. When this work has been carried out, the next step will be the establishment of large plots of the chosen species on which animals will be fed and records of the effects upon the animals made. An area for this experiment has been reserved, and the whole of this area is being kept under uniform treatment until required.

Seasonal Yields Experiment.—In order to make a detailed comparison of the performance of eight grass species which have been chosen as the result of the earlier work, a series of small plots has been established in a randomized block arrangement. These are to be subjected to a system of monthly cuts and a comparison made of the aggregate and seasonal yields. A similar experiment on a larger number of grasses was previously attempted, and, although information of value was obtained, locust attacks made it impossible to complete the work. The species in the present experiment include those few which were found capable of withstanding the severe cutting treatment in the former experiment.

Strains of Rhodes Grass.—Three, possibly more, clearly different strains of Rhodes grass have been obtained. Three of these are included for comparison in the above seasonal yields experiment.

Fodder Crop Experiment.—Six types considered suitable for feeding green and as ensilage in the high altitude and intermediate areas are being compared at Kabete on the basis of yield of green and dry matter. The investigation is to be extended to the yields of nutrients by arrangement with the Chemical Section. These types include several plants commonly used by natives for feeding green. The experiment is now well established, and the yield cuts have been started.

Ten One-tenth-acre Seed Production Plots.—With a view to obtaining planting material of the more promising pasture plants in the work for use in more extensive trials, an obviously essential step was the setting up of seed production plots. Accordingly, ten species of proved seed-producing qualities have been established. Unfortunately, few of the indigenous grass species are well suited to this purpose. The majority either produce little viable seed or the seed ripens unevenly and is partially shed before it can be harvested. During the year the first crops were taken from some of these

plots, and although the species used had given good results on a small scale, the results were somewhat disappointing. This was mainly due to uneven ripening of the grasses.

Experiments at Ngong Animal Husbandry Centre.—The altitude of this station is just over 6,000 feet, and the average rainfall approximately 35 inches. The grassland work at the centre, which is situated a few miles from Kabete, is conducted from the central station. The experiments consist of an investigation into the effects of different intensities of grazing and of grass burning on the natural herbage, which is here dominated by *Themeda triandra* Forsk. (Red Oat grass), and trials of pasture and fodder plants. The work affects both native and European agriculture.

During the year the grazing and burning treatments have been continued, and they have now been stopped with a view to making records of the herbage. The three-acre paddock of Rhodes grass established in 1934 has given very satisfactory results, and an experiment to compare the intensive management of this pasture with unlimited natural pasture will be referred to later.

The Comparatively Dry Areas.

Work at the Experimental Station, Naivasha.

This station is situated at an altitude of 6,200 feet, with an average rainfall of approximately 25 inches per annum. The vegetation consists of scattered trees of *Acokanthera*, with a herbage in which *Cynodon plectostachyum* Pilg. is strongly dominant, often constituting a pure stand of this grass. The area on which the station is situated is apparently part of the ancient bed of Lake Naivasha. Desiccating winds are a feature of the local climate.

The grassland experiments here are also controlled from Kabete. They consist of trials of pasture and fodder plants, a manurial experiment similar to the one at Kabete, and the experiment described in the 1934 Report which is designed to investigate the possibilities of finding an economic method of renovating pasture which has been seriously depleted by locust attack and drought. This last experiment consists of sown strips of a number of chosen grasses and legumes with various surface treatments of the soil. The whole of the work has so far been conducted under exceptionally severe climatic conditions, and little success can be claimed.

Trials of Herbage Plants.—The plots for trials of drought-resistant herbage species is in a very exposed position, and over several years of trials Rhodes grass from the 1934 sowing is the only type which has survived, and this only to a limited extent in depressions of the land. The grass is at present in a vigorous condition following recent rain, and it is believed that if once satisfactory establishment can be attained it may prove to be a very useful type in this dry district.

Renovation of Pasture Experiment.—In the case of this experiment, seed sown in one rainy season did not germinate until the next, owing to the abnormally low rainfall. In the early stages of development a number of types, particularly of the legumes, gave some promise, but later they failed to survive, and now only one of the sown grasses is clearly in evidence. Even this species (*Amphilophis pertusa*) does not appear to have greatly increased the bulk of herbage available on the strip. The outstanding feature of the area in general is the remarkable recovery of the natural cover of *Cynodon plectostachyum* (Star grass), and one may be forced to the conclusion that no type which can be introduced can help appreciably in the recovery of these depleted pastures. The all-important factor is evidently moisture, and even after years of severe conditions it appears that this grass is capable of rapid recovery and of producing a cover more quickly than any of the species artificially established.

Manurial Experiment.—The preliminary trials of mineral fertilizers at Naivasha have given less marked results even than those observed at Kabete. Throughout the period of the experiment moisture has again been the limiting factor, and the effect of this, e.g. in slight depressions of the land, has masked any effects which may have resulted from the various treatments. It is fairly evident that the use of fertilizers is not an economic proposition in these dry areas of the country, where intensive management of pasture is also unlikely to be practicable.

A manurial experiment on the same plan was conducted on the Athi Plains, near Nairobi. The rainfall is here intermediate between that of Kabete and Naivasha, and the herbage is dominated by *Themeda triandra*. Again temporary effects from the nitrogenous mineral fertilizers were observed, and a marked and more permanent effect from the application of farmyard manure. Apart from these, no other results were visible from examination of the herbage.

Work at Kitale, Njoro and Animal Husbandry Centres.

As the more promising species are isolated in the course of the work at Kabete, material is sent for trial at centres in various parts of the country. The two main stations used for this purpose in European areas are those at Njoro and Kitale, where the work is carried out by the agricultural staff. At both these centres during the year, amongst other species, the Australian strain of Rhodes grass has progressed from small observational plots to fairly extensive sowings intended for grazing trials.

The Animal Husbandry Centres in a number of different parts of the country have been used mainly to demonstrate pasture species which have passed the preliminary stages of the work and can be used on a large scale. Areas of Rhodes grass are now in use at the centres at Ngong and Machakos, and seed has been supplied to Baraton, Sangalo and Maseno.

Apart from experiments which have been undertaken at Ngong, these centres serve an important purpose in extending the use of the proved pasture types by bringing them to the notice of both European farmers and natives.

Kitale.—The Kitale centre is representative of the greater part of the Trans Nzoia area in general. It is situated at an altitude of just over 6,000 feet, and has an average annual rainfall of approximately 45 inches.

The vegetation consists of a savanna formation in which common trees are *Ficus* species near *F. sycomorus* Linn., and a *Combretum* species near *C. petitianum* A. Rich. Another tree which occurs occasionally in this vegetation is *Faurea speciosa* Welw. Species important in the herbage are *Themeda triandra* Forsk., *Hyparrhenia filipendula* Stapf., and, in parts, *Hyparrhenia Ruprechtii* Fourn. Many other grasses are of frequent occurrence.

The grassland work at this centre consists mainly of : (1) observational plots of pasture and fodder species, (2) grazing trials of natural and artificially established pasture, and (3) plots of sown and planted species and mixtures intended for grazing trials on a nearby farm.

The results to date may be summarized as follows :—

The observational plots of pasture plants have shown the superiority of a number of grasses and have served to demonstrate the inferiority of species of temperate origin in general (as far as these have been covered by trials) for use under the

climatic conditions of the greater part of the Trans Nzoia. From an examination of the plots in December the following species appeared to be the most successful :—

Cynodon sp. (local).

Paspalum dilatatum Poir.

Brachiaria brizantha Stapf.

Chloris gayana Kunth. (Trans Nzoia strain).

Setaria sp.

Chloris gayana Kunth. (Australian strain).

This list is slightly different from that of the most successful grasses at Kabete, as would be expected from the different climatic conditions, and it shows the necessity for trials in individual districts. Of the above-named grasses, *Paspalum dilatatum* is distinctly more successful under Trans Nzoia conditions, and, although not included in this series of plots, *Melinis minutiflora* (Molasses grass) is also better suited to the Trans Nzoia than to Kabete and a number of other districts.

With regard to legumes, it cannot be claimed that a successful pasture legume has yet been found.

In the case of the grazing paddocks, the indications are that controlled grazing over a period of three years has had no marked effect upon the botanical composition of the herbage, although the trials have been purely observational and no records of the herbage have been made.

This herbage consists mainly of the following species :—

Hyparrhenia filipendula Stapf. : Dominant or co-dominant with *T. triandra*.

Themeda triandra Forsk.

Trichopteryx kagerensis K. Schum. : Frequent.

Brachiaria brizantha Stapf. : Frequent.

Brachiaria soluta Stapf. : Occasional.

Cynodon plectostachyum Pilg. : Occasional.

Digitaria scalarum Chiov. : Occasional.

Eragrostis tenuifolia Hochst. : Occasional.

In the artificially established pasture *Pennisetum clandestinum* (Kikuyu grass) has remained strongly dominant over two or three years, and *Melinis minutiflora*, *Brachiaria brizantha* and *Paspalum dilatatum* are all occasional in occurrence. In addition to these, most of the species mentioned in the

natural pasture have invaded the plots to some extent. Although still dominant, the Kikuyu grass gives the impression of being definitely less productive and less permanent than in areas of climatic conditions to which it is suited.

Mineral fertilizers have been used in strips on this artificially established pasture. At the time of writing (December) no effects from the fertilizers were visible except that on the strip where no mineral dressings had been applied the herbage was distinctly poorer both as regards ground cover and the nature of the species present.

With regard to the plots established on Wartnaby's farm, a few miles from the agricultural centre, no grazing has yet been undertaken owing to the fact that the owner has left the farm for an indefinite period. This again illustrates the advisability of confining work which will necessitate careful observations in the later stages as far as possible to Government land.

Examination of these plots shows that the most successful grass species are *Paspalum dilatatum*, *Chloris gayana* (Australian strain), *C. gayana* (local strain), and *Melinis minutiflora*. The mixtures of European species are of low productivity under these conditions, and are, at present, decidedly unpromising, while no legume which is distinctly successful appears to have been included in the trials. This information agrees with that obtainable from the small observational plots at the Kitale centre.

Plots of Napier grass, lucerne and *Panicum trichocladum* have been established at Kitale, with a view to trial as reserve fodder for dry periods. Of these types, the first-named is the only one which has given satisfactory preliminary results to date.

Njoro and Sub-stations.—The Njoro centre is situated at an altitude of 7,200 feet and the average annual rainfall is just over 37 inches. From the vegetation it is evident that the moisture conditions are higher than those of the Rift Valley floor in general, but an examination of the vegetation also suggests that the rainfall is, in fact, rather lower than the above figure, which is based on records over four years only. In the immediate vicinity of the station, the vegetation consists of scrub-grass, in which the prominent woody species are *Tarchonanthus camphoratus* Linn. ("Ol'leleshwa") and occasional *Acacia* sp., while the dominant in the herbage is *Themeda triandra*, except in places where recent disturbing factors have been at work.

Investigation has shown that the conditions at this centre are somewhat peculiar and cannot be regarded as representative of any considerable areas yet encountered. In addition to the vegetation briefly described above, representatives of various stages of the plant succession found in the high-altitude moist areas appear in the herbage wherever disturbing factors occur, but the moisture conditions are evidently too low for the higher stages of this succession. Thus the concentration of animals, as in intensive grazing management, results in a change from *Themeda triandra* herbage to the undesirable coarse-grass stage in which *Pennisetum Schimperii* A. Rich. is dominant. This stage cannot be converted successfully to the higher Kikuyu grass stage as in the moist areas at high altitudes, with the result that the coarse *Pennisetum* occupies the land to an increasing extent, and the herbage deteriorates for the purpose of grazing.

The work at Njoro consists of the following main sections :

(1) a series of small observational plots of pasture species, (2) four paddocks of natural herbage grazed rotationally by a small herd of native cows, (3) a fifth paddock sown down to strips of various mixtures of grasses and legumes, together with one strip allowed to revert naturally, (4) observational plots of various fodder crops, and (5) renovation of pasture experiment on Sewall's farm a few miles away from the station, where two species of grass have been sown pure and as mixtures under two types of cultivation, with a view to finding a means of improving a pasture depleted by locusts and drought. This is similar to the experiment at Naivasha, already reported under the Kabete centre.

Owing to the distinctly different conditions of the neighbouring districts of the Rongai Valley and Molo, sub-stations have been established on farms at both these places. The climate of the former district is drier than that of Njoro and more subject to drought, while that of the latter is fairly typical of the areas of high moisture and low temperature, being situated mainly between altitudes of 8,000 and 10,000 feet, with an annual rainfall of from 50 to 60 inches.

At Rongai there are observational plots of pasture species and fodder crops, while at Molo are (a) small plots of pasture species (mainly temperate and sub-tropical), (b) larger plots of the more promising species for grazing trials, (c) plots of fodder crops, and (d) on a second farm, a manurial experiment on the same plan as those already reported upon for Kabete, Athi Plains and Naivasha.

The progress of this work during the year is outlined below.

The more promising species from the series of observational plots at Njoro have been established in strips intended for grazing trials.

The intensive grazing of the natural pasture paddocks has been continued, and some of the effects upon the herbage have become evident. When records of the herbage were made on these plots by the writer at the start of the experiment, it was realized that intensive management would probably lead to an increase of the inferior *Pennisetum Schimperi*, and this has proved to be the case according to observations made subsequently by the Agricultural Officer at Njoro. It is intended to continue the grazing treatments in order to confirm this result, and to obtain records for comparison with the initial records. It has already been pointed out that the particular area of the Njoro Plant Breeding Station is vegetationally representative of a very limited district, and therefore, if it is found that intensive management of the natural pasture is not a practical proposition, it must not be assumed that these results necessarily apply to the neighbouring districts. It is obviously desirable that grazing trials similar to the above should be conducted in more representative areas, such as the Rongai Valley and Molo, if facilities can be made available.

The renovation of pasture experiment on Sewall's farm, although near to Njoro, is situated under distinctly different climatic conditions, which are believed to be representative of considerable areas. The main results observed from an examination of the plots in December are (a) that ploughing and disc-harrowing have produced better results than disc-harrowing alone, and (b) that Rhodes grass (Australian strain) gives distinct promise of success, especially in the ploughed strips.

At Rongai the trials of pasture and fodder species have given some information as to the types which should be included in further work. Amongst the more successful pasture species observed during the year were :—

Amphilophis pertusa Stapf.

Cenchrus ciliaris Linn. (erect strain).

Chloris gayana Kunth. (Australian strain).

Chloris gayana Kunth. (Trans Nzoia strain).

Setaria sp.

Brachiaria brizantha Stapf.

Melinis minutiflora P. Beauv.

Little success has been obtained with pasture legumes, apart from some promise given by lucerne and Hubam clover as a fodder crop.

With regard to the experiments at Molo, which are situated on a farm at 9,200 feet altitude, the work deals mainly with European pasture species. A number of the more promising grasses have been isolated from the observational plots, and these species were put under grazing conditions during the year. They are: Italian rye grass, Perennial rye grass, Danish Meadow Fescue, Cocksfoot, *Phalaris tuberosa*, and *Bromus marginatus*. It appears that some of these grasses will be suited for short leys in rotation with wheat in the limited areas of the country above, say, 8,500 feet altitude. This line of work is quite apart from the management of Kikuyu grass, which is considered to be the main pasture problem of the Molo area in general, and it is hoped that it will be found possible for the staff at Njoro to devote more attention to collaboration in work on this problem.

Rhodes Grass Trials.

The progress of the trials of this grass made during the year are worthy of special note. In continuance of a trial started in 1934 to determine the range of climatic conditions over which the grass could be used successfully, a further twenty-two issues of seed were made during the year. The reports received to date have continued to show very satisfactory results, and the indications are that this grass can be used with confidence for both pasture and hay over considerable areas of the highlands. So far, definite success has been obtained in areas ranging roughly from 5,000 to 8,000 feet with average annual rainfall of from about 25 to 55 inches, although the actual rainfall experienced during the trials was in practically all cases well below normal. Success was obtained on a variety of soils, including those of the "black cotton" type.

The use of this grass for grazing was continued at the Scott Agricultural Laboratories and the Ngong Centre, while yields of hay averaging approximately three tons per acre were obtained at Kabete. At the Scott Laboratories the grass is being used as part of the pasturage connected with a demonstration native smallholding.

Attention has been given to seed production, and it has been shown that yields of 200 lb. and over per acre can be obtained. At least one farmer has sown an area with a view to seed production on a fairly large scale, and it is hoped that this idea will be extended.

With regard to legumes for use in mixtures with this grass, the fact, already referred to, that indigenous *Indigofera tettiensis* has given considerable promise should be mentioned.

In order to compare the grazing derived from a paddock of Rhodes grass during the dry season with unlimited natural pasture, an experiment was carried out in collaboration with Mr. J. Anderson, Instructor in Stock at the Ngong Centre. Two matched groups of native cows were used, the one fed entirely on a three-acre plot of Rhodes grass and the other on a fenced area of one hundred acres of natural pasture intended to represent unlimited natural pasture. A drinking trough was situated in this latter paddock. The herbage, which is dominated by *Themeda triandra*, is typical of the area in general and of considerable parts of the country.

The experiment was started on the 23rd July, 1935, and continued until the 20th October, 1935. During this period 2.40 inches of rain fell. An examination of the natural pasture area on the 8th November, eighteen days after the grazing had ceased, showed that there was an abundance of mature herbage remaining.

For the first ten days of the experiment the yield of milk from the natural pasture was greater than from the Rhodes grass, after which, for the period from 2nd August to 7th October, the yield from the latter was 122 lb. in excess of that from the natural pasture for the group of eight cows, or an average of 15.23 lb. per cow. On the 7th October the grazing on the Rhodes grass paddock was more or less completely cleared, and the yield of milk began to fall.

This experiment serves to indicate the possibilities of properly managed Rhodes grass pasture as compared with the prevalent method of allowing animals to range over extensive areas of natural herbage. It should be mentioned that the natural pasture at Ngong is generally considered to be above the average for the country in quality. If it had been possible to use higher yielding cows than the native animals available, there is little doubt that the results would have been more marked.

The important conclusion to be drawn from this work is not so much that the Rhodes grass has resulted in a distinctly higher yield of milk than the natural pasture, but that heavily stocked areas of this grass can be used successfully in the dry periods of the year, and may serve to lengthen the period in which grazing can be made available.

To sum up with regard to the progress of work on this grass, there is every reason to believe that, as suggested in the 1934 Report, it is a type well suited for use in the areas of intermediate climatic conditions and for the production of pasture and hay on disused arable land over a large portion of the country.

PROGRESS OF GRASSLAND WORK IN NATIVE AREAS.

A large proportion of the area of Kenya is occupied by the stockowning native tribes, and the possibility of development of these tribes is obviously connected closely with the management of grassland. In addition to this, the rapid deterioration of extensive areas of this grassland, and the alarming advance of soil erosion within recent years, demands the application of remedial measures which, it is maintained, can only come through comprehensive methods of control of grazing.

Apart from these considerations, the advancement of the agricultural tribes in the areas of more favourable moisture conditions necessitates the development of mixed farming, as against purely crop production, both from the point of view of human nutrition and the conservation of soil fertility. This necessity is already becoming more marked with the limitation of land available for cropping as the population of the areas occupied by these tribes increases. An essential part of the development towards mixed farming is the introduction of intensive methods of pasture management.

Reconditioning of Grassland.—The great pastoral tribes, such as the Masai, Turkana and Samburu, occupy the regions of erratic rainfall, and it is here that the real menace of soil erosion exists, resulting from the depletion and often complete removal of the vegetational cover over extensive areas. The limitation of stock is obviously necessary if progressive deterioration is to be avoided, but this alone is unlikely to solve the problem, and, judging from the information available, it is difficult to attribute the condition of some of the native pastoral areas entirely to overstocking as such. The evil probably lies mainly in the mismanagement of the grazing which has been accentuated by the limitation of the areas over which these nomadic tribes are able to move. The problem can only be attacked successfully by the application of methods which affect extensive areas, and these methods, to give any hope of success, must be, at least in some measure, compatible with the existing customs of the tribes concerned.

The Kamba tribe present a somewhat different problem in that they occupy an area of higher rainfall conditions, and a considerable measure of family ownership of land has already developed. Although they are primarily a stockowning tribe, crop production is also important. Widespread deterioration of the grasslands has taken place, and soil erosion is spreading rapidly. In dealing with this area it will be necessary to base the plans for reconditioning upon comparatively small areas of land, apart from several large, communally held portions of the reserve.

During the year a general scheme for the application of a simple method of control of grazing was drawn up. The main idea embodied in the scheme is the control of movement of the stockowning tribes so as to limit the injurious practice of continual early grazing on the same areas, and to provide for seed production of the main herbage species. This amounts to rotational management of large areas according to a simple plan.

It is intended that, in the case of each tribal area, an experiment should be conducted in the application of the method on a portion held by a section of the tribe. Towards the end of the year, a committee was set up in the Ukamba area in order to apply the scheme. This committee, which is representative of the Local Native Council, the Administration and the Agricultural Department, is at present occupied with the preliminary survey work necessary with regard to conditions of land tenure, etc.

Grassland Management in Relation to Stock Farming Amongst the Agricultural Tribes.—As already pointed out, the development of some measure of stock farming is of fundamental importance to the progress of these tribes. In the first place it is calculated to lead to a higher level of human nutrition, and secondly it will prove to be an essential factor in the conservation of soil fertility, as with the increase of population, more intensive methods of crop production become necessary.

The Kikuyu and similarly placed tribes are at a distinctly higher stage of development than that of the nomadic pastoral natives. This fact is of course closely connected with the more favourable moisture conditions of the areas in which these agricultural tribes live, and the idea of native smallholdings, which has been adopted by this Department, seems well suited to this type of country. The plan presupposes the existence, as part of these holdings, of small areas of pasture capable of

withstanding intensive management. It is fortunate that, over a large part of the high-altitude region concerned, a type of pasture admirably suited to intensive management can be developed by employing the correct principles of management. This pasture consists of *Pennisetum clandestinum* (Kikuyu grass) and *Trifolium Johnstonii* (indigenous clover), and it can be produced and maintained by methods readily available to the native. These methods have been described elsewhere.

The main necessity is to demonstrate on smallholding lines the possibilities of intensive management of this grass and the methods by which swards of it can be developed in place of the less desirable herbage which is usually found. Work of this kind has been started by the Provincial Agricultural Officer at Nyeri in collaboration with the writer.

Only a portion of the areas occupied by the agricultural tribes is within the high altitude, potential Kikuyu grass zone, but these tribes are in general under comparatively high moisture conditions. In these areas at somewhat lower altitudes, two main lines of pasture investigation are necessary in order to facilitate the smallholding idea: (1) determination of the effects of intensive grazing of the natural herbage in the various areas concerned, and (2) the introduction of sown or planted pastures in rotation with food crops.

The former has not yet been undertaken, but trials of pasture plants have been established during the year at Fort Hall. At this centre Rhodes grass (Australian strain) has shown marked success according to the preliminary reports.

The production of fodder crops for use in the dry periods of the year is also closely bound up with the possibility of developing the smallholding plan, and work on promising types is already in progress at various centres. In this connection, the more detailed work on fodder crops in progress at Kabete has a definite bearing on the requirements of the higher altitude native areas, as has also the work on pasture species, which has already produced types likely to be of value under native conditions.

The Problem of Grass Burning.—This matter affects all parts of the country which are occupied by the pastoral tribes. There has been much expression of opinion on the question, but as yet there is a very slight basis of reliable information on which to act. The practice is extremely widespread, and constitutes a deeply seated native custom.

Preliminary work has been in progress over the past three years, as mentioned under the heading of "Experiments at the Ngong Centre." It is now realized, however, that although the information obtained is believed to be applicable to the extensive Acacia-Grass savanna type of country, there are a number of further types of vegetation in areas where burning is customarily practised on which information is desirable.

The findings to date at Ngong may be summarized as follows :—

(a) An accumulation of the old growth from season to season results in weakening of the dominant type in the herbage, *Themeda triandra*, an increase in the growth of shrubs and apparently a thinning of the plant stand in general, with a consequent increase in the proportion of bare ground.

(b) Preventing the accumulation of old growth by either grazing or burning appears to have had a similar effect in the opposite direction. *Themeda triandra* has remained strongly dominant, and the growth of shrubby plants has been retarded. The ground cover has improved under the heavier grazing treatments.

On the extensive grasslands under native occupation, fire is often the only instrument available for clearing this accumulation of dead herbage. If employed in the dormant season, which is usually the case in native grass burning, it is most probable that the practice cannot be reasonably condemned. It is very desirable, however, that further investigation should be made, and with this object in view it is hoped to extend the work at Ngong, and to set up simple experiments to determine the effects of grass burning in the different vegetational areas where it is employed by the natives.

Such experiments would follow, as far as possible, the prevalent native practice in the districts concerned, and would be situated at or near centres such as Embu, Fort Hall, etc.

HERBARIUM.

The collection of herbage plants was added to considerably during the year, and duplicates of all specimens were sent to the Royal Botanic Gardens, Kew. It is desired to acknowledge the valuable assistance received from that source in the identification of pasture species.

D. C. EDWARDS,
*Agricultural Officer in Charge of
Grassland Improvement.*

Part II.—Plant Breeding Section

REPORT OF THE SENIOR PLANT BREEDER AND EXPERIMENTALIST

The staff of the Plant Breeding Station, Njoro, for the year under review consisted of :—

Mr. R. J. Lathbury, Plant Breeder,
Mr. R. S. Ball, Agricultural Officer,
Mr. R. N. Noble, Laboratory Assistant.

Mr. R. J. Benstead, the district Agricultural Officer, was transferred to Kavirondo, and Mr. Ball took over the district work in addition to his duties on the station. Mr. Noble, whilst devoting much of his time to the breeding work, assisted also in the general work of the station and of the district.

A field day was held on the station on 20th September, which was attended by some fifty farmers.

Mr. Lathbury attended all meetings of the Wheat Advisory Board.

Mr. Gamble was in charge of the wheat breeding work at the Scott Agricultural Laboratories, under the supervision of Mr. Lathbury, and undertook himself the specialized work on the improvement of Muratha maize.

I was appointed Acting Deputy Director (Plant Industry) from the 2nd March to the 29th September, and after that was on special duty to the end of the year. Mr. Lathbury was therefore in charge of the work for the best portion of the year and the following report was written by him, with a few additional notes added by myself to give a complete picture of the season's work, as some of the experiments laid out by Mr. Lathbury were not quite finished before his departure on leave at the end of the year. Mr. Ball was of the greatest assistance in all the work going on at the station. He has specialized in the bean breeding work, and the reports on this have been written by him. Mr. Halcrow, the Agricultural Officer, Trans Nzoia, continued the work on maize breeding begun and carried on there by Mr. Colin Maher for the past four years, and his report is included in the section on maize. The thanks of the Plant Breeding Section are again due to the Senior Plant Pathologist for valuable assistance with rust epidemics and seedling inoculations of new strains of wheats with the different physiologic forms of stem rust, and to the Agricultural Officer at the Scott Agricultural Laboratories for help rendered.

G. J. L. BURTON,
Senior Plant Breeder and Experimentalist.

WHEAT—GENERAL.

The year 1935 may be called a rust year, compared with the years 1933 and 1934. In the previous two years the comparatively small acreage sown—about 40,000 acres—ensured that there would be little wheat available for export, despite the good growing seasons experienced and the absence of rust. Under these conditions, and with an all-over average of four bags per acre (many farmers obtained a considerably larger yield), in both years, wheat has been a most profitable crop to the grower, even in these times of depressed prices. This year, however, whilst the acreage has increased by 10 per cent, the yield per acre has fallen, and a great deal of low-grade wheat has been reaped, due to a rust epidemic over most of the country. This was owing to the fact that the form of stem rust present was No. K4, the latest discovered form, and the form to which most of the present wheats grown in this country are susceptible.

The wheat-growing areas on the whole have received good rains, though they have been somewhat local in character in certain districts, and some individual farms have been unlucky in this respect.

The main varieties of wheat grown are much the same as last year—that is, Kenya Governor in the lower altitude areas and N.B. 230 in the higher. Additionally there was a certain acreage sown to Equator, Burbank, and B.256.C.3.(L), whilst the area sown to B. 256.G., the Kabete wheats, and Cross No. 112 was restricted to the small amount of seed available of these new wheats. Owing to the adverse reports on the milling quality of Sabanero wheat, a small acreage only of this variety was grown, and whilst it failed to maintain its rust resistance of previous years altogether, yet it was not damaged to anywhere near the same extent as other more susceptible wheats. This wheat is more thrifty than other varieties on some of the poorer types of soil, and the small amount required by the mills should therefore if possible be confined to these soils and to districts for which a suitable rust-resistant wheat is not at present available. Wheat No. N.B. 230 and Kenya Governor both suffered from damage by stem rust, but Kenya Governor, unlike N.B. 230, showed itself to possess some morphological resistance to this rust, provided the infection was not too severe. Of the new hybrid wheats, B. 256.G. and the Kabete wheats rusted owing to the presence of K4, the only form of stem rust to which they possess susceptibility. On the other hand, Cross No. 112, which is only

susceptible to form K2, generally did very well, and growers were very pleased with its performance. Equator has again shown its great susceptibility to stem rust, and is better not grown. Burbank also, like the Kabete wheats, is very susceptible to form K4 of stem rust, and had better be discarded under present conditions.

Physiologic Forms of Stem Rust.

No new form materialized, but the year was noteworthy for a heavy epidemic of form K4. This form has shown itself to be most virulent, and was present all over the country. Not only does it appear at a very early stage on the wheat, but it is notable for its appearance at this stage low down on the plant on the first node and internode of the stem above ground. Form K2 was also present over parts of the country, generally together with form K4, and in one case a farmer growing two wheats, one of which was susceptible to K2 only, and the other to K4 only, lost them both through these two forms being present together.

The wheat stem rust studies in co-operation with farmers, initiated in 1934, were continued and increased. The four Kenya differential hosts, or "tester wheats" as they are generally called, were given to eighteen farmers, all of whom had new wheats growing. The majority of these farmers were subsequently visited, and the reactions of the differentials noted. Excellent reports and specimens were received from the few growers who were not seen, and all these gentlemen are cordially thanked for undertaking this work. Results in all but one case showed K4 to be present, whilst in four cases K2 was also present. Additional specimens of stem rust were collected from the growing crops and sent down to the Mycological Section for identification. Results of these specimens show K4, and to a lesser extent K2, to be present, thus confirming the results obtained in the studies above.

The Canadian wheats which in that country possess a mature plant resistance to stem rust were again tried, but it is clear that the conditions responsible for mature plant resistance in this country, whatever they may be, do not respond in the same way here as in Canada, all these wheats showing some but not complete susceptibility to stem rust. Climatic conditions in this country may be responsible for this different behaviour. It is worth mentioning that one of the Canadian wheats, namely D.C. x Ceres 721, which possesses mature

plant resistance in that country, is in this country physiologically resistant to all our physiological forms of stem rust. This should prove a useful wheat in districts of an altitude up to about 7,500 feet, where yellow rust is not very destructive.

Diseases.

Apart from stem rust, which has done considerable damage, yellow rust was also prevalent, and wheats such as Kenya Governor and Burbank, which ordinarily are only slightly affected at 7,500 feet, have this season suffered considerable loss from this species of rust when grown at such altitudes. Leaf rust, whilst present, caused little appreciable damage.

“Take-all” disease, which has largely lain dormant for two years, was present, and this disease, particularly in the Molo-Mau Summit area, is responsible for much loss. It has appeared largely in the “whiteheads” stage, and there is no question but that the measures for its eradication must be strictly enforced on all affected land. Observations, both at the 9,000 feet and the 7,000 feet altitudes, have shown that one year’s rotation or fallow is insufficient to starve out this disease. Furthermore, the disease can stay in a more or less dormant condition in the soil for several years if conditions are unsuited to its spread. Farmers are therefore warned not to be lulled into a false sense of security if the disease after its first appearance does not spread the following year.

Black chaff was present to a small extent, whilst glume blotch was much in evidence in some districts. This latter disease was not seen on an otherwise healthy crop, but was generally secondary to rust or to a lodged crop. A further mercurial dusting experiment was laid down with Agrosan G. at Njoro, but no significance was obtained, though the season was again dry.

Darnel is still persistent in some crops, and growers who have this weed are urged to take the necessary steps to remove it. Such growers, at any rate, should carefully rogue any wheat fields from which they intend to sell seed.

Analyses of Baking Quality.

Further samples of new wheats have been sent to England, through the courtesy of Messrs. Unga Ltd., for analyses of baking quality by Dr. Kent Jones. Whilst the relation between the “stability” and “general strength” figures for some of these wheat samples grown at Njoro were fairly

even, it was noticed that samples of the same wheats grown at Molo (9,200 feet) displayed excessive stability figures in relation to their general strength figures. Further observations and tests indicate that, at any rate in the case of some crosses, there was a connection between excessive stability and high altitude. Tests to confirm this fact have been carried out, and a number of strains of wheat have been grown at a high and a low altitude centre. The analyses of the samples from these tests have, however, not yet come to hand. A condition such as the above is only one of the many difficulties which have to be overcome in the production of wheats suited to such varying altitudes.

The chemical section, in conjunction with Mr. Gamble, have now evolved a suitable local technique for the use of Pelshenke's Wholemeal Fermentation Time Test. A number of trial tests have been done on some of the wheat samples sent to England, and the order of merit for general strength obtained by this test has approximated very closely to the order of merit shown by the analyses of baking quality.

Now that a suitable technique is known it would be most unfortunate if lack of staff prevented the utilization of this test in the case of all pure line hybrids.

Wheat Breeding at the Plant Breeding Station, Njoro.

Another dry season was experienced. The wheats, however, grew reasonably well, and it was only found necessary to water the cage hybrids.

Form K4 of stem rust was naturally present on the station, though it was not very severe, and later in the season a slight natural infection of form K2 was also experienced. The cage "surround" was inoculated with all forms of stem rust. Where however the hybrid wheats were known to be susceptible to one form only of stem rust, the surround adjacent to these hybrids was inoculated with that particular form alone, so that these hybrids should receive the maximum amount of infection. Two methods of creating an artificial infection were adopted. The early method consisted in making up a spore suspension of each form of rust and applying this to the leaves of the "surround" wheat. The method of application was by rubbing the suspension on with the fingers. The treated plants were subsequently covered with "V" glass covers for forty-eight hours to obtain the necessary humidity. This treatment was adopted when the plants had formed their second leaf. The second method was used just before the "surround" wheat came into ear. A spore suspension was

again made up and injected into the top internode of the culms by means of a hypodermic syringe. Whilst the second method has to date given more satisfactory results and is easier of application, it is considered desirable to use both methods, for the reason that should the injection method fail through adverse climatic conditions there would not be time to repeat the procedure, as the hybrid wheats would be advanced beyond the stage at which they are most receptive.

The "take" in each case was successful, with the exception of form K2, which showed a slight infection only with the early method and a fair infection with the injection method. Form K2 has always appeared late rather than early in the season at Njoro, and it is felt that a heavier infection of this form might be secured at that time when climatic conditions are presumably likely to be at their optimum for its creation and spread.

One other matter of interest was the observation that the uredospores of form K3 appeared definitely lighter and more of an orange rather than a reddish colour compared with the uredospores of the other forms. This observation, however, was only noticeable when the pustules of spores had been shaded from the light. They became the normal colour after light had filtered through better on the plants growing older.

In addition to the artificial cage "surround", all pure line hybrids were grown in triplicate in three blocks well separated from each other. The respective differentials for K2, K3 and K4 were used as the surround and artificial infections of each form were created, Block No. I, for instance, being infected with K2, Block II with K3, and so on. As the differentials for these forms are each susceptible only to the form they represent, the rust present on the "surround" would of necessity only be the form to which the differential was susceptible. Whilst K4 rust would of course be present naturally and attack the hybrids in, say, the K2 block, yet if it was known which wheats were susceptible to K4, then all wheats rusting, except those susceptible to K4, must have been infected by the "surround" rust.

It was not possible to make use of form K1 in the same way, as this form was lost early in the year. K1 is a difficult form to maintain pure, as no variety of wheat at present in our possession is susceptible only to that form. It was, however, recovered at the end of the year, and all the necessary experiments which were postponed in 1935 will be done in 1936.

Cross No. 112.—Njoro Hybrid x English Hybrid from Cambridge.

Over 1,000 acres have been sown to strains of this wheat in 1935, and both at 7,000 feet and 8,500 feet yields of twelve bags per acre off 20-acre and 100-acre fields respectively have been reported, whilst in fact it has everywhere shown itself to be a heavy yielding wheat. It possesses susceptibility to form K2 of stem rust only. This form of stem rust is the form generally present at the high altitudes, to which this wheat is suited owing to its resistance to yellow rust and to the time it takes to mature. However, this wheat has never rusted with K2 to the extent that Equator has (in fact, it is not quite so susceptible), and furthermore, this form of rust appears, as would be expected, to lose some of its virulence at the higher altitudes to which these wheats in particular are suited. At 6,000 feet the only strain of 112 wheat grown rusted badly, whilst at 7,000 feet a moderate infection only was present, and at the higher altitudes none or only a slight infection was observed. This wheat has shown itself to be highly resistant to the new form K4, and for this reason alone it is proving of great value, as it is the only wheat available in bulk at the moment which possesses this resistance, with the exception of Sabanero, which has some resistance.

The future of the wheat depends on its milling quality, which is likely to be moderate only, and on its ability to escape damage by form K2 of stem rust at the higher altitudes. Large-scale milling tests are being carried out on this season's crop, so that results should be available before the 1936 sowings.

(1936 *Note*.—Recent analyses of baking quality disclose great differences in protein quality between the different strains of this cross, the general strength of some being good, though the stability is almost invariably rather too high. The best have been kept, and should prove extremely useful wheats. The excessive stability is undoubtedly due to the milling qualities of the original Njoro hybrids.)

Crosses No. 117 and 122.—Njoro Hybrids x Marquis.

A few strains were issued for farmers and about a hundred bags all told have been harvested. Some strains are susceptible to form K2 of stem rust, and others can just be called resistant. They are resistant to forms K3 and K4 of stem rust, and though it has not yet been possible to do seedling inoculations with form K1, there is no reason from

field tests to suppose that they are not resistant to it. They are susceptible to yellow rust above 7,000-7,500 feet. They should be useful wheats for the 7,000 feet level.

They have excellent grain, some being red and others white in colour. Their yielding ability is only fair, being not quite up to the standard of Cross No. 112. Preliminary analyses of baking quality, however, have shown some of them to be equal to No. 2 Manitoba as regards protein quality, and it is felt that this promised quality will always ensure a demand for them and secure good prices for export.

Two or three further strains have become available for issue, and one of these at any rate promises to yield well.

Cross No. 130.—Njoro Hybrid x Australian Florence Selections.

A number of strains have been multiplied up, and some of these have now reached the bag stage. Whilst seedling inoculation tests have shown some of these to be resistant to form K2 of stem rust, this has not been altogether borne out in the field, where a certain amount of rust has been present. They are definitely resistant to K3 and K4, and are also resistant to yellow rust—even more so than Cross 112. Field tests with all strains and an inoculation test with one strain suggest that these wheats are resistant to form K1.

A further series of cultures of a later generation have been isolated in which resistance to K2 has been obtained both in the field and confirmed by seedling inoculations. These cultures also possess good straw and a better shaped grain than most, and it is hoped that one or two only of these strains will eventually be kept as suitable for growing between 7,000 and 9,000 feet.

The grain is likely to be superior in quality to Cross No. 112, though not so good as Crosses Nos. 117 and 122. Some strains possess red grain and others white.

(1936 *Note*.—Recent analyses of baking quality suggest that one, if not two, strains of this cross now in the bag stage possess really good protein quality, and that two strains of a later generation possess extremely good protein quality in the best Manitoba class; these latter happen to possess white grain also. A great step forward appears to have been made with this cross; such good results in protein quality were unexpected.)

Cross No. 131.—Njoro Hybrid x Australian Florence Selections.

Strains have been obtained which are resistant to all four forms of stem rust and also to yellow rust. The grain of some looks good and has bushelled well, despite its rather long ugly shape. The only other disadvantage is that the straw appears to be of moderate to weak strength. In view of the rust resistance possessed by this cross it is hoped that something useful will materialize.

(1936 *Note*.—Recent analyses of baking quality show that one strain at least possesses excellent protein quality and another quite good quality. Stress has been laid on baking quality because of the difficulty experienced in getting rid of the poor baking quality of the Njoro hybrid rust-resistant parents.)

Cross No. 58.—Red Egyptian x Kabete Hybrid (B.F4.3.B.10. V.1.(L).

Strain No. 58.F.(L.1), which is resistant to all four forms of stem rust, has been multiplied up, and about 40 bags have been reaped, some of which is being grown on through the short rains to increase the supply for next year's sowing. This wheat was grown at Kabete, Naro Moru, Rongai, Njoro, and Plateau, and remained free of rust, though rust was bad on other wheats at all these centres. It is a very good yielding wheat of moderately early maturity, but susceptible to yellow rust over 7,000 feet. Analyses of baking quality suggest that it will be quite an acceptable wheat to the mills.

Cross No. 172.—Njoro Hybrid x Reliance.

Plants in the third filial generation from this cross have been selected, and these show no signs of stem rust, whilst possessing grain of promising appearance. It is expected that something of value will be obtained from this cross, especially as the Njoro hybrid is resistant to all forms of stem rust, and Reliance is susceptible to K3 only.

Crosses Nos. 202 and 203.—No. 112 Hybrid x Kabete Hybrids (Nos. 286.B.11.B.(L) and B. 60.B.12.B.14(L).

This cross is in the F₂ generation only, but a number of plants free of rust have been harvested, and it is hoped eventually to obtain early maturing, good yielding, white grained plants, resistant to both stem and yellow rust.

Other Crosses.

Crosses Nos. 142, 162, 133 and 146 have now been finally discarded.

A number of crosses in the F1 generation were grown on, and further crosses made, with the intention of combining in a further series of wheats the best qualities of the new hybrids produced at Njoro and the Scott Agricultural Laboratories.

Yield Tests.

A randomized-block yield test of thirty-four varieties of wheat was laid down. Yield tests of this nature, when repeated over several years, prove of considerable value in the final selection of wheats for issue to the country. Owing to damage by "Take-all", preliminary indications of yield only were obtained.

Wheat Breeding at the Scott Agricultural Laboratories.

As described in previous reports, the wheat breeding work at the Scott Agricultural Laboratories consists in breeding from the so-called Kabete hybrids new wheats resistant to form K4 of stem rust as well as to the other three. The Kabete hybrids had been bred from Kenya Standard before the physiologic form K4 had appeared. The necessity for this further work is emphasized by the complete destruction of the Kabete hybrids by form K4 this year almost wherever they were grown.

The F2 and F3 selections out of the new crosses were sown and rust-resistant plants harvested. These plants mostly had Reliance (resistant to forms K1, K2 and K4) as one parent, the other being of course a Kabete hybrid necessary to retain early maturity as well as being resistant to forms K1, K2 and K3 of stem rust. The use of these two types of wheat as parents should serve to facilitate the elimination of susceptibility to forms K3 and K4 of stem rust respectively.

Reliance is a red-grained wheat and the Kabete hybrids are white-grained. Of all the plants harvested only 15 were white-grained, and these, on account of the local importance of this colour, have been given a special double multiplication, making use of the short rains. The remaining F4 red-grained cultures which comprise the bulk of the material will be sown next year, as it is not possible to create a satisfactory artificial epidemic of rust during the short rains, but seedling inoculation tests on fifteen white-grained cultures only can be easily done.

A further series of crosses between the Kabete wheats and the new high-altitude Njoro wheats was made, and the F1's grown on during the short rains.

Pure-line strains of a further cross, No. 179, which would appear to be fairly resistant to all forms of stem rust and of good milling quality, were also grown on in the short rains, as well as two acres of wheat No. 58.F.(L.1) for multiplication.

The routine work of seedling inoculation of new hybrid wheats was carried out by Mr. Gamble under the direction of the Senior Plant Pathologist.

The Kabete wheats, to which reference has been made in previous reports, were subjected to a comparative yield trial, but owing to their extreme susceptibility to form K4 of stem rust it has since been found necessary to discard them all.

These Kabete wheats were issued to farmers on a large scale, and it is unfortunate that in this, their first year of trial under ordinary farming conditions, they should be destroyed by form K4 of stem rust, the only form to which they are susceptible, and which had not been epidemic until this year.

Wheat No. B.256.G. was also destroyed in places by form K4 of stem rust, though elsewhere it escaped this rust. Apart from this susceptibility, it grew and yielded well, and has the advantage over the Kabete wheats than it can be grown another thousand feet higher, up to nearly 7,000 feet, without succumbing to yellow rust.

Molo Sub-station.

Apart from serving its usual function as a station for testing for yellow rust, a randomized yield trial of the more promising high-altitude wheats was laid down, and the results obtained show that the selected strains from Crosses Nos. 112, 130 and 131 yield better than Wheat No. N.B. 230 and than the Njoro hybrid parent No. K.2.R.5.(L.2). It was also used as an oat-rust testing station.

OATS.

Further trials were conducted at Njoro, Rongai and Molo of the more promising of the Australian varieties referred to in the Annual Report for 1934. At Njoro all varieties proved susceptible to stem rust, whilst at Molo the variety Lampton alone did not rust. This variety is being multiplied, as despite its susceptibility at Njoro this year it is more resistant than anything else in the country. Issues of Biffen's hybrid were also made, as this oat is very suitable for hay or for ensilage.

A series of oat differentials obtained by the Plant Pathologist were also grown at the above three centres, so that the number of physiologic forms of both stem rust and crown rust might also be identified.

MAIZE BREEDING.

At Njoro twenty-six F4 lines, embracing one hundred and thirty-three selections, were planted. Twenty-three single crosses were also planted, and eight of these were double crossed. 402 plants out of the twenty-six lines were selfed, whilst twelve single crosses were made.

In spite of an adverse maize season, and rather poor growth of the maize, selfing results were satisfactory. Very definite types have now segregated in these lines, the outstanding characters being as follows:—

(1) *Earliness*.—One line three to four weeks earlier than the main crop. This character is obviously of considerable importance in an area near the limit of maize cultivation, where the growth period is very prolonged.

(2) *Thickness of Stem and Good Root Anchorage*.—One line of short, thick-stemmed maize, very well anchored in the ground, has segregated out.

(3) *Resistance to Disease*.—The resistance of some lines to white blight was very marked. With regard to *Fusarium*, there was a considerable variation in the plant infection and also in the cob infection, some lines being particularly free from the latter. As there was a heavy infection of *Fusarium* in all the ordinary field maize, it would appear that lines promising in this respect have been produced.

(4) *Foliage Characters*.—These characters show probably the widest divergence, both with regard to size, breadth and colour of leaf. Narrow, upright types have been discarded in favour of broader, better coloured and denser foliage types.

(5) *Position of Cob on Stem*.—In many lines the cob is situated too high up on the stem, and types are being selected where the cobs are situated lower down.

(6) *Grain Characters*.—In general a flinty type of grain, which weighs heavily, is being selected. The lines show wide divergence with regard to these characters. Attention is also being paid to the number of cobs per plant and the weight of grain per cob is being tested in the crosses.

The crosses made in 1934 which were planted in 1935 showed considerable increases in yield over the ordinary mass-selected outbred seed. There was, however, a fairly wide variation in yield, and five lines particularly were outstanding as parents, these being all lines which have shown valuable individual characters, and these characters have reappeared in the crosses. The remarkable uniformity of all the plants in these crosses is worthy of note. Every plant produced a maximum yield, and none of the great inter-plant variability as seen in an ordinary field of maize was observed. Double crosses were then made between these five most promising lines, in order to obtain seed of sufficient size to be suitable for issue to the farmer and to maintain continuous vigour.

Mr. Halcrow, the Agricultural Officer, Trans Nzoia, reports as follows on the maize breeding work done by him at the Experimental Station, Kitale :—

“ The inbred lines were planted for the first time at the Experiment Station, Kitale. Various circumstances made the work during the year extremely difficult. Rainfall for the year was ten inches above normal, and several severe hailstorms did considerable damage to the leaves of the plants, making white blight and rust determinations difficult and at the same time destroying many bags and incidentally not a few possible selections. The major trouble, however, was the unforeseen sourness of the new land, which hindered germination and interfered with the proper development of the plants, in spite of liberal applications of ammonium sulphate. The patchy nature of the land and the presence of numerous anthills made real comparison between the lines well-nigh impossible; little value can be put on such criteria as height, vigour and leaf colour, though, fortunately, judgments on disease resistance can be taken as more or less comparable. In the circumstances the very greatest pains were taken, by referring to their past history, to keep as many of the lines going as possible.

“ The bottle method of pollinating was used, and the usual score-card system of judging for disease resistance was followed. For the self-pollinated F4 material, the dates of pollinating were recorded as usual direct in to the maize breeding book, but for the crossed F5 material a new procedure had to be devised. As far as possible crosses were made between lines as distantly related as possible, and with due regard to earliness and their respective degrees of resistance to the three diseases. The disparity in time that inevitably obtains in individual plants in the appearance of the

silks and anthers made the task of crossing selected lines extremely arduous.

“ To ensure the requisite number of selfed plants and crosses (including reciprocals) the following method of note-taking was adopted: The first thing every morning the plants were carefully examined and recorded for the presence of silks and anthers as follows:—

Row Number	No. of Plants Marked	Row for Crossing	Anthers Ready	Silks Ready	Selfed	Crossed	Crossed
1	15	8-18	F, etc.	B,C, etc.	EKMN O	8PQOI N	18 BH- J, K
5	7	18	C, B, etc.	B	DRFG	18, A,N	
6	5	—	C	E	ABEC D		

As the various anthers and silks were used they were marked out on the sheet. Some lines had to be crossed with as many as four lines; with the aid of this plan it was possible to see at a glance how many plants were ready, how many selfings and crossings had been done, and hence how many more were required. Particular attention was paid to the necessity for having at least five self-pollinated plants in every line. Every evening the work done during the day was entered in the maize breeding book. This system worked admirably.

“ The breeding material consisted of 274 lines retained from 1934, of which 137 were F5 and the majority of the remainder F4 lines. The lines were judged by the usual method for general uniformity and resistance to white blight (*Helminthosporium turcicum*), *Fusarium* sp., and rust (*Puccinia sorghi*). As a result, 103 lines were selected. In these lines, 1,270 pollinations were made, of which 262 were cross-pollinations (including the reciprocal crosses) between various F5 lines. No attempt was made to cross F4 lines; they were self-pollinated only. At harvest, after rejecting cobs for various reasons such as disease, dirty pith, bad type and inadequate number of grains, 365 cobs were retained for planting out in 1936, of which 122 are from cross-pollinated F5 lines, 108 are the F6 generation, while the majority of the remainder are F5. Many of the crossed cobs have inherited extremely high resistance to *Fusarium* and white blight, and it will be interesting to watch their

performance in 1936, when for comparison they will be planted side by side with the ordinary outbred seed maize of the station.

“ At harvest time, for the sake of interest, the open-pollinated cobs of all the lines were broken and examined. Of the lines rejected earlier in the year on vegetative characters, only eight showed any tendency to yield clean cobs, i.e. they had more than 50 per cent clean cores.

“ Throughout the Trans Nzoia this year, maize diseases were more prevalent than usual, and the breeding maize was not behind in this respect; pink ear rot, *Nigrospora* and *Diplodia* were all represented, the last named being the most conspicuous.

“ I have to record my gratitude for the invaluable assistance of Mr. C. F. Fox during the period 17th July to 4th October.”

The work on improvement of Muratha maize was the particular responsibility of Mr. Gamble. Some twenty-two acres were put under this crop at the Scott Agricultural Laboratories as well as a further two acres at the Church of Scotland Mission at Kikuyu. Plant selection in the field was particularly concentrated on a half-acre block planted with seed from five cobs obtained from five very virile plants of the previous year, which showed marked resistance to white blight and *Fusarium* diseases. Further plant and subsequent cob selections of highly resistant plants from this half-acre were made during the year, and these will form the nucleus for further work on this maize.

The second best seed from the 1934 crop, that is, seed which showed definite resistance to white blight, was planted on the two-acre block at the Church of Scotland Mission, Kikuyu, where, owing to the altitude, it would get a thorough test for that disease. Unfortunately, this crop suffered severely from army worm and was finally destroyed by locusts.

The remaining $21\frac{1}{2}$ acres at the Scott Laboratories was planted with what may be termed the third grade seed. This was subjected to rigorous plant selection by Mr. Gamble and was divided into two lots—that highly resistant to white blight, and that partially resistant, the plants in all cases being vigorous.

All the field-selected maize is being retained for further breeding purposes at the Laboratories, the best seed being put at the inside of the field. The cobs considered worthy of

retention from the field-selected maize were further divided into two classes : Class I seed consisted only of cobs with very white, bright pith and absolutely free from disease, whilst Class II seed consisted of cobs with pith which, though not discoloured, was of a somewhat dull white colour, so that a small proportion of the seed showed a very slight trace of disease.

The remainder of the cobs which did not belong to selected plants were carefully crib-selected for type, and on being broken open were again divided into two classes on pith colour. This seed, consisting of about sixteen bags, was issued to the seed farms in Central Province for further propagation and selection before issuing to native farmers. Any reasonable looking cobs which remained were shelled and the seed, consisting of some 100 bags, was issued to the Agricultural Officer, Kiambu, for direct distribution to native farmers, as that district has been somewhat short of Muratha seed in the past.

The average yield of Muratha maize at the Scott Agricultural Laboratories was 18 bags to the acre. This is a great advance on previous yields, and is largely due to the improvement in type resulting from the intensified and improved breeding adopted during the past few years.

Maize Seed Competition.

The maize seed competition was again run in three sections, at Njoro, Rongai and Kitale respectively. The number of entries was good, totalling twenty-nine, with, in addition, three entries from Government stations. The year was a difficult one for maize, yields depending largely on the date of planting. A drought was experienced at Njoro and a severe one at Rongai, and at Kitale severe storms damaged the maize.

The results of these competitions have been published in full detail in the Press, but it may be said here that, at Njoro, the highest yield was 9.03 bags per acre and the lowest 4.03 ; at Rongai, the highest yield was 5.65 bags per acre and the lowest 2.94 ; at Kitale, the highest yield was 12.07 bags per acre and the lowest 5.42. Great differences were noticed in comparative quality of entrants' seed, as to disease resistance and type, and these differences are reflected in the yields obtained, which are sufficiently great to demonstrate of themselves the paramount importance of proper and careful selection of seed.

The actual securing of the top place in any one section in any one year is not so important as appearing in the top quarter or half of the ranking lists each year for the five years the competitions have been in existence. This shows consistency in quality of seed, and several farmers have regularly appeared in the first half, and a few almost always in the first quarter and never below the first half. It is from such farmers that seed should be obtained.

The 1935 results have confirmed the strong effect of acclimatization, and the first half of the ranking lists in the sections at Njoro, Rongai and Kitale were almost invariably occupied by local entrants. Farmers desirous of buying seed have been recommended to do so from successful competitors in the section of the competition conducted in their own district, or, if there was no competition there, in that district most similar climatically to their own.

The results of the 1934 competitions were exhibited, in the form of original and progeny cobs, in February of this year at Farmers' Days at Kitale and Nakuru, held under the auspices of the Royal Agricultural and Horticultural Society of Kenya, and lectures on the subject of maize seed were given by the Senior Plant Breeder and Experimentalist. Bags of seed were also exhibited by competitors who had been placed in the first half of the ranking list, and were judged on appearance only. Competitors were informed that any seed they sold should not be inferior in apparent freedom from disease and type to that exhibited at the Farmers' Days. In regard to seed transactions, the firm of Estates and Investments, Ltd., who farm on a large scale in the Trans Nzoia, have demonstrated their faith in the results and value of the competitions by purchasing quantities of seed at a high price from consistently good performers, and the quality of the seed offered has been excellent in appearance.

These competitions are run under the auspices of the Royal Agricultural and Horticultural Society of Kenya, and with the invaluable assistance of the Society's Secretary, Mr. M. F. Hill. The field work in these competitions was carried out by the Agricultural Officers in the districts concerned.

MADAGASCAR BUTTER BEANS.

Mr. Ball reports as follows :—

“ In the past, consignments of butter beans have been turned down on the home market owing to a percentage of the beans being affected with ‘yellow eye’, an infection of

the hilums which causes a black discoloration on cooking. Experiments have been carried out the last two years to see if this infection was hereditary or due to outside conditions, such as climate. Results from this year's breeding experiments indicate that infection is inherited. Strains have been obtained which are resistant, and these strains will accordingly be multiplied up."

BACTERIAL BLIGHT RESISTANCE IN *Phaseolus vulgaris*.

Mr. Ball reports as follows:—

" This disease is most prevalent at elevations of 7,000 feet upwards under wet conditions, and the successful growth of this crop has therefore been largely limited to areas under this height. The varieties mainly worked with were Canadian Wonder and some of the canning varieties. Variation was observed in the field and plants resistant to this disease were picked out and their progeny grown on separately. Most of these selected lines are now in the F2 generation from the selection, and promise well, though at this stage it is too early to be definite about results."

PYRETHRUM.

Not only is pyrethrum a cross-fertilized plant, but in this country at any rate it would appear to be self-sterile. This fact naturally limits breeding work, which is particularly desirable considering the great variation between plants to be found in any pyrethrum field. The grower is, however, recommended to establish a mass-selected plot for seed purposes. Such a plot has been laid down at Njoro. Additionally, each selected plant has been increased by divisions and once these are established yields will be taken of the different single-plant lines. The best of these lines will be crossed together, and the subsequent seed tested out against the general mass-selected seed and ordinary non-selected farm seed.

Crosses have also been made between selected individual plants and the resultant seed is being compared with mass-selected seed.

A half-acre block of pyrethrum has also been established to test out the response, if any, of the crop to the application of fertilizers.

R. J. LATHBURY,
Plant Breeder.

Part III.—Chemical Section

REPORT OF THE SENIOR AGRICULTURAL CHEMIST STAFF.

The Senior Agricultural Chemist was absent on long leave from 16th March to 29th September, during which he attended the Third International Congress of Soil Science. Mr. Burton, Junior Laboratory Assistant, was absent on leave from 3rd September to the end of the year. Mr. Gethin Jones, Soil Chemist, and Mr. McNaughtan, Laboratory Assistant, were on duty throughout the year.

As there is no longer any routine chemical work being undertaken on behalf of the Division of Animal Industry, the number of samples examined during the year is much less than in former years but many of the samples now received involved days of work so the volume of work done has increased rather than decreased. The nature of the samples is given in tabular form below :—

NATURE OF SAMPLE	Pending 31-12-34	Received	Examined	Refused	Pending 31-12-35	Total
Soils.. ..	—	349	322	—	27	349
Fertilizers ..	—	47	47	—	—	47
Pyrethrum ..	—	30	30	—	—	30
Essential Oils	—	51	51	—	—	51
Coffee	—	5	5	—	—	5
Sisal.. ..	—	38	38	—	—	38
Crops	—	6	6	—	—	6
Miscellaneous	—	19	19	—	—	19
TOTAL ..	—	545	518	—	27	545

SOILS.

The greater part of the soil work is discussed by Mr. Gethin Jones, the Soil Chemist, in his report.

The writer attended the Third International Soil Congress at Oxford where a number of very useful contacts were made. As a result of a number of discussions it appears certain that a uniform system of soil classification will develop throughout Africa as regards the major soil groups. Parallel soil types to those of East Africa occur in South Africa and in West Africa. The composite soil map of East Africa, drawn by Mr. Milne from those produced by the various constituent territories, aroused a good deal of interest and helped to crystallize ideas.

A survey party spent some time on the Baringo Plain in connection with the Perkerra Irrigation Scheme. As far as soluble salts are concerned the soil is admirably suited to irrigation. The mineral plant nutrients are ample but there is a deficiency in nitrogen. Pot experiments indicate that a marked response is obtained to nitrogenous manuring. There is no doubt that it will be possible to devise a system of cropping which will overcome this deficiency.

There has been considerable interest taken in soil erosion this year and a fair number of farmers have protected their land by means of the various anti-erosion measures described in Bulletin No. 1 of 1935. There is no doubt that anti-erosion measures are absolutely essential in the greater part of the native reserves. Large accumulations of silt, sometimes a foot thick, have been observed on flat areas in hilly country after storms. It is considered that a great deal of this erosion is due to the increased production of cash crops. Large blocks of land are being planted, and too often the cash crops are in pure stand exposing the soil to direct beating by the rain. It is recognized that active steps are being taken to find suitable interplanting crops but at the same time one is forced to the conclusion that mechanical anti-erosion measures are essential. Of all the terracing methods the only one capable of wide application to the native reserves is that of "box-terracing". No levels have to be taken, very little labour is entailed and they are very efficient.

MANURES.

The Soil Chemist reports on the fertiliser work during the year but certain points in connection with composts call for attention here.

Working on spent still waste from the essential oil laboratory, material which is practically sterile, a very rapid decomposition was obtained after inoculation from an old compost heap. In one case only three weeks was needed for the conversion of the fresh waste into a good manure. Later experiments, conducted after the writer had returned from leave, were most unsatisfactory. Very little heat was produced and action was very slow. It appeared that an utterly different flora had been introduced whose action was different. Probably this observation explains why on farms sometimes the decomposition is slow and the heap is cold. Work is being continued as opportunity permits.

One noticeable point in most of the samples of compost being brought in is the large amount of soil in them. By the time decomposition is complete a good "potting compost" is left which would hardly be worth while transporting.

PYRETHRUM.

While on leave the writer was invited to attend the inspection of a number of bales of Kenya pyrethrum. It was evident that there had been no bulking of the pyrethrum from different estates; one bale showed three different types. This practice has now ceased and pyrethrum is well mixed before baling.

The pyrethrum survey showed very little difference in the pyrethrin content of flowers from various parts of the Colony. Towards the end of the year most inconsistent results were obtained and the method of analysis used has been abandoned. The method now being employed is much more expensive in both material and time, but gives consistent figures. It is being employed in the investigation on pyrethrum drying now in progress.

As regards driers the demand has been for cheap driers. The conclusions to date are that as long as the construction of the drying building has not been poor good drying is obtained, but often the building has been too cheaply constructed and, owing to cold air entering through cracks, drying is unduly prolonged. A full report will be published elsewhere.

ESSENTIAL OILS.

The work on essential oils has been a continuation of that of last year. Details of the work are being given in a series of articles now being published in the *East African Agricultural Journal*.

COFFEE.

Owing to the writer's absence on leave little work has been done on coffee during the year. The latest developments in spectrographic analysis which is to be applied to coffee were studied during leave and the most modern apparatus for the purpose was ordered. The primary object in the purchase of the spectrographic apparatus is to explore the possibility of some deficiency in mineral nutrients, probably of the minor elements, being responsible for the susceptibility of coffee, in certain districts, to coffee berry disease. The method of spectrographic analysis will be applicable to

the general study of the mineral nutrition of coffee. Accumulation of data from such analyses should provide some most interesting information regarding the requirements of coffee for the minor elements such as copper, zinc, etc.

SISAL.

An investigation into the preparation of sisal line fibre and sisal tow has been undertaken by Mr. Gethin Jones who deals with this in his report.

GENERAL.

During the year the Section has collaborated with the Plant Breeding Section in the study and development of a rapid simple method of assessing the quality of wheats. The method is very sensitive to conditions but, providing that all mixing and kneading are done by a single worker, a very fair indication of the quality of the wheats is obtained.

The writer wishes to record his appreciation of the work done by the staff of the Chemical Section.

V. A. BECKLEY,
Senior Agricultural Chemist.

REPORT OF THE SOIL CHEMIST

During the year, 322 samples of soil and 47 samples of fertilizers were dealt with, leaving a balance of 27 soil samples taken in connection with investigational work towards the end of the year. An analysis of the soil work gives the following classification of laboratory work involving soil analysis: 98 soil samples were examined and reported upon for private individuals; 112 samples dealt with laboratory investigation work whereas the remainder, including those mentioned by the Senior Agricultural Chemist, dealt with general and irrigation survey work. In past annual reports, the writer has intimated that he would encourage farmers to bring representative soil samples to the department's laboratories where manurial and cultural problems can be discussed and simple soil tests carried out. It is pleasing to record that the number of such soil samples examined has about doubled since the previous year and the Chemical Section would again bring to the notice of farmers that this service exists and that soil tests are carried out and advice given free of all charges. There has also been an increase in the number of fertilizers reported upon, this increase being largely due to the greater interest taken in compost making during recent years. A summary of the analyses carried out includes 18 samples of compost, 10 local guanos, 9 mineral and by-product fertilizers, 5 natural licks and 10 local lime and limestones. The preparation and utilization of local animal by-product fertilizers has now become established. The various materials form very suitable fertilizers for local conditions and are sold at comparatively low prices. The limestone survey of the Colony has now more or less come to an end. It has been shown that local deposits of fair to good quality limestone occur throughout the greater portion of the farming areas.

SOIL INVESTIGATIONAL WORK.

Kikuyu Red Loam.

Further laboratory investigations on the phosphate-status of Kikuyu red loam, the major coffee soil of the Colony, has been continued. These have confirmed the original statement that this class of soil exhibits a very delicate equilibrium between its so-called "available" and "unavailable" phosphoric oxide content. There is rapid replacement from the "unavailable" reserves as the more available portion is removed by acid extraction. Again added phosphates show an equally rapid change over into the temporarily unavailable form and cannot be removed without long continued leaching by dilute acid. Such a soil with added phosphate will liberate

more phosphate to solution than an untreated soil, thus indicating a continuously higher availability in the field in spite of the removal of the phosphate as it is rendered soluble. Further trials were carried out by mixing with the soil equal amounts of phosphoric oxide in the form of mineral phosphate direct and again in intimate conjunction with maturing compost so as to compare the reactions of this less readily soluble form with the water-soluble super-phosphate. The percentage solubility of the mineral phosphate in acids of varying strength was compared with its solubility after compost treatment. With the stronger acids there was no appreciable difference as nearly the whole was dissolved in both cases, but with very weak acids and with water there was a very slight reduction in solubility after composting. This is probably due to the formation of a protective layer round the fertilizer particles and small amounts being metabolized and made temporarily unavailable by the compost micro-organisms. Equal amounts of phosphates in these various forms were thoroughly mixed with soil and acid solubility or availability tests carried out using nitric acid of varying strengths. The results showed no marked differences, the proportion of added phosphate recovered by leaching 100 grs. soil with four litres of fifth normal acid being of the order of 56 per cent, 60 per cent and 51 per cent for mineral phosphate with compost, mineral phosphate direct and super-phosphate direct respectively. Thus one finds that the less soluble form of phosphate when added to the soil direct or in conjunction with compost become even less soluble : they attain about the same apparent availability as added super-phosphate. It is probable that the dispersed particles are partially dissolved by the percolating acid, and that the dissolved portion is immediately fixed in a much less soluble form by the surrounding reactive sesquioxide colloids of the soil under the acid conditions of the extraction. If this is the case, then arbitrary methods of analysis again mask the true phosphate-status of the soils as they affect plant growth. These results suggest that the cheaper forms such as mineral phosphates are at least as suitable as the more expensive chemically prepared water-soluble forms in the special case of these laterized red acid soils. One might even expect the cheaper forms to be more suitable as the less soluble individual particles are less likely to be converted into the less available form by the reactive soil colloids and would therefore remain as local centres of slightly available phosphate which can be absorbed by direct contact with the feeding root system of the plant. Again this form is more amenable to a better distribution by subsequent

cultivation. Bone meals might be expected to be specially suitable as the associated nitrogen content would provide local centres for vigorous root development. The true availability of different forms of phosphatic fertilizers will have to be tested by the growth of a series of plants under pot culture conditions. This investigation has shown that for this type of soil chemical soil analyses form an unreliable guide for advisory work on phosphatic manuring. A series of extractions has to be carried out and the evidence supported by practical crop yield trials.

Coffee.

The series of coffee trees grown under cramped conditions in sand culture were allowed to overbear with a disproportionate amount of leaf and hence to suffer severely from dieback of wood and root tissues. The strain was so severe that most of the trees ultimately died; the order of deaths being of the same order as the apparent strain of overbearing. The tree receiving no nitrogen, which had always been the least vigorous and poorest yielder is the only one which has survived and it has since commenced to produce new growth. Growth measurements taken while the trees were vigorous showed that the elongation of the lateral primaries was suppressed during the later stages of carrying fairly mature and ripening cherries, whereas non-bearing and poor cropping laterals continued to make growth. Thus young trees which had carried the heaviest crop tended to become more conical in shape, whereas those carrying a smaller crop tended to become more domed in shape. This suggests that individual or blocks of more dome-shaped young trees might be associated with a poorer cropping performance than trees which tend to be more conical in shape.

Pastures.

The grassland manurial experiments carried out in conjunction with the Officer in charge of Grassland Improvement have not yielded any outstanding observational results. In the case of the black cotton soil of the Athi Plains, applications of boma manure and to a lesser extent sulphate of ammonia as periodical top-dressings have given a slightly earlier and more bulky darker green growth. On the Kikuyu red loam at Kabete a similar result was noticed: also it was noticed that phosphates encouraged the growth of indigenous clover during the rains but the effect is hardly noticeable during dry seasons. It appears that the supply of soil moisture is the dominant factor in the production of pasturage and that

when this is limited over the greater portion of the year, it becomes uneconomic to apply concentrated fertilizers. It is likely that pasture improvement can be brought about more by the control of grazing and paddocking rather than by the application of bought-in-fertilizers.

Sisal.

During the absence of the Senior Agricultural Chemist, the writer, in co-operation with various sisal growers, carried out some laboratory work on the better preparation of line fibre and on the reclamation of sisal tow. It has been shown that it is possible to reduce the acidity and water-soluble content of line fibre and reclaimed tow by efficient washing after decortication. Line fibre prepared by dry or almost dry decortication methods contains very much more adhering water-soluble non-fibre constituents and a higher initial acidity than wet decorticated fibre, but subsequent washing and drying in a centrifuge can reduce these supposed adverse factors to almost the level of wet decortication. The total amount of water required is less and hence subsequent washing might have a special application on estates where the water supply is inadequate or irregular. The cleaning of reclaimed tow presents many difficulties and an elaborate treatment is necessary to remove the major portion of the non-fibre materials and their contained acidity. In general, it would appear that efficient washing and rapid drying make for a less acid and cleaner fibre, but it has yet to be shown that these measures of preparation produce a better, higher price article on the sisal market.

SOIL SURVEY.

Partly owing to the absence on leave of the Senior Agricultural Chemist during the year, the amount of field work performed has been very limited. In conjunction with the Provincial Agricultural Officer for the Central Province a survey of the northern portion of the Yatta Plateau, with special reference to the possibilities of irrigation, was carried out. Generally speaking, the major portion of the soils of the district are fairly shallow, low in inherent fertility and not very suitable for any irrigation scheme. There are large areas of chemically rich black cotton type of soils which have suitable topography and high resistance to erosion but which would be very difficult to cultivate and unsuitable for irrigation. From a soil point of view the suggested irrigation scheme by tapping the waters of the Thika River cannot be recommended as very lengthy furrows would be required and the

land under command is definitely second-class land for this purpose. However, the most striking feature of the Yatta from a development point of view is the great need for a supply of accommodation water during the greater portion of the year.

Towards the end of the year, the writer, in conjunction with other members of the Chemical Section and an irrigation officer of the Public Works Department, carried out a fairly detailed irrigation survey of the alluvial flats to the south of Lake Baringo. The soil conditions were found to be favourable to the proposed irrigation scheme using the waters of the Perkerra River. The Senior Agricultural Chemist deals with this in his report.

SOIL CLASSIFICATION AND NOMENCLATURE.

Owing to limited amount of field work undertaken during the year under review, little attention has been given to this sphere of work. Soil samples collected during economic surveys have been classified and a few new soil series names have been allotted to certain soil conditions. A summary of the recorded soil series has been submitted to the East African Agricultural Research Station, Amani, for registration and later correlation with similar soils met with in East Africa. It is appreciated that final correlation will have to be done by different soil workers working together in the field.

GENERAL.

A paper dealing with the conservation of soil fertility on coffee estates, with special reference to anti-erosion methods, was read at the Coffee Planters' Days.

At the Agricultural Show in July, special attention was given to a major exhibit illustrating various practical methods for combating soil erosion.

G. H. GETHIN JONES,

Soil Chemist.

Part IV.—Report of the Entomological Section

STAFF.

Mr. Wilkinson remained seconded in charge of the Coffee Berry Disease investigations in Sotik until the 24th May, when he left for a tour of inspection in connection with maize stalk borer in the Rift Valley Province; from the 16th June to the end of the year he remained at the Scott Agricultural Laboratories in charge of the Entomological Section.

Dr. Le Pelley, Entomologist, was absent throughout the year continuing his studies in America as a result of the award of a Commonwealth scholarship.

Mr. F. B. Notley, Entomologist, was responsible for the work of the Entomological Section from the 1st January to the 16th June.

Mr. H. Naismith Jones, Plant Inspector, remained in charge throughout the year of the Kasarini Experimental Station during the absence of Dr. Le Pelley.

Mr. C. D. Knight, Plant Inspector, was stationed at the Scott Laboratories throughout the year.

Mr. A. J. Cooper, Plant Inspector, resigned from the Service on the 15th May, 1935.

Mr. E. Cottington returned from leave on the 5th May and was seconded to the Botanical Section for duties in connection with coffee berry disease investigation in Sotik.

Mr. Fielding Fox was engaged as a Plant Inspector as from the 15th July.

ADMINISTRATION.

Correspondence and general routine work continue to increase and take up practically the whole time of the officer in charge of the Section.

The importation of plant material, seeds, etc., has increased considerably and in addition to the consignments inspected at the port of entry hundreds of packages of plants and seeds arriving by post have been inspected.

Plant material arriving by air is also on the increase. Owing to the speeding up of transport it has been considered necessary to discuss at the forthcoming Amani Agricultural

Conference the general principles governing air transport of plant materials, with a view to minimizing the possible introduction of insect pests and fungous diseases.

The export of plant material, bulbs, seeds, etc., is generally on the increase. This material is inspected thoroughly by responsible officers before certificates are issued, stating that to the best of their knowledge the material is free from insect pests and disease. It is hoped in this way that confidence in these certificates will be established in other countries.

NEGLECTED PLANTATIONS.

Considering the financial difficulties experienced by many planters as a result of the reduction in world prices for agricultural products, it is gratifying to report that few estates are in a state of neglect.

EXTENSION WORK.

During the year ten planters' meetings were attended and lectures delivered on coffee berry disease, *Hemileia*, *Antestia*, pink disease, *Lygus*, *Thrips*, *Stephanoderes*, maize stalk borer and white borer (*Anthores*).

The Coffee Planters' Days held in July were attended, and papers read on "Thrips in Relation to Climate" (by Mr. Notley) and "White Borer in Coffee" (by Mr. Wilkinson).

An entomological exhibit was staged at the Agricultural Show held in Nairobi on the 4th and 5th of July.

Amani Conference.

Memoranda to be submitted at the forthcoming Agricultural Conference have been written on (a) "The Influence of Climate upon Agricultural Processes and the Susceptibility of Crops to Attack by Insect Pests", (b) "*Stephanoderes hampei*, Ferr.", (c) "Progress Report on the Introduction of Parasites of Mealy Bug (*Pseudococcus kenyae*)".

INVESTIGATIONAL WORK.

Coffee Mealy Bug.

Mr. Notley reports as follows:—

The Kenya common coffee mealy bug which heretofore has been known as *P. lilacinus* was redescribed by Dr. Le Pelley in the course of his studies in America as *P. kenyae*,

on account of certain constant differences which this insect shows from type specimens of *P. lilacinus*. The name *P. kenyae* is used here throughout.

Mealy-bug work was considered to take precedence over all other work. Three lines of research were pursued. The first was the introduction of parasites of species of *Pseudococcus* other than *lilacinus* in the hope that one or more of these might breed in *P. kenyae*, and the second the introduction of parasites of *P. kenyae* from Bukoba through the courtesy of the late Mr. Ritchie, and from Uganda. The third was an investigation of the climatic requirements of *P. kenyae*.

With regard to the first, only one consignment was received, being parasites of *P. kraunhiae* from Honolulu. This parasite failed to breed in *P. kenyae*.

A predatorial *Cecidomyid*, described as *Schizobremia coffeae* Barnes, was received from the late Mr. Ritchie from Bukoba, and this was successfully reared in the laboratory. Its breeding here, however, is slow, and doubts are felt as to its probable usefulness under Kenya conditions.

Two other parasites were received from Mr. Ritchie, neither of which was induced to breed here. One of these was later identified as *Anagyrus aurantifrons* which is already present in Kenya as a parasite of *P. perniciosus*.

In October I was sent to Kampala to study *P. kenyae* there. The insect was found with little difficulty, and several species of parasites were obtained, but it was found that the total parasitism was low, and insufficient to account for the low status of *P. kenyae* as a pest there. *C. robusta* is attacked if anything more freely than *C. arabica*. The main parasite found was again *Anagyrus aurantifrons* and evidence was found which indicated *P. kenyae* has a considerable resistance to this parasite even in Uganda. In Kenya this resistance appears to be practically complete. *P. kenyae* was found as far west as Toro, on *C. arabica* at about 5,000 feet. Two *Coccinellids* were found feeding on *P. kenyae*, namely *Scymnus luteus* and *Hyperaspis* ? *pumila*; the latter has not been recorded from Kenya and was introduced, but failed to breed here. Also a *Lycaenid* (*Spalgis* sp.?) which also failed to breed; this latter was introduced previously to Kenya in 1927, but failed to become established.

The evidence goes to show that the reason for *P. kenyae* being a minor pest in Uganda is not the presence of parasites there which are absent in Kenya, but is probably climatic.

Work on the climatic requirements of *P. kenya*e continued, but was held up by technical difficulties and the necessity of pursuing other lines of research. The conclusions reached above, however, indicate the increased importance of this line, and it is being taken up again. Work so far completed has given valuable indications, but it would be premature to discuss these.

Early in the year it was decided that the most promising method of attack on the mealy bug problem lay in the search for *P. kenya*e and its parasites in the Far East, and an application to the Colonial Development Fund was made for funds to carry out this search. If the funds are made available, it is intended that Dr. Le Pelley should commence this work on the completion of his work in America.

Antestia.

The long range work laid down by Dr. Le Pelley in connection with bionomical and ecological studies of *Antestia* has been continued. Dr. Le Pelley remained in America on a Commonwealth fellowship throughout the year. He continued to direct the work of the *Antestia* Field Station at Kasarini by correspondence, and reports as follows:—

The *Antestia* investigations fall into two categories. Firstly, detailed experimental studies of control measures at present in use in East Africa, with further work designed to improve the methods found most valuable in Kenya. Secondly, a study of *Antestia* in relation to its climatic and biotic environment.

Work on these lines has proceeded and certain portions of it have been concluded.

Certain phases of the study of *Antestia* in relation to its environment have proceeded without interruption. Others await my return to Kenya for active prosecution or conclusion. Several phases of this study were planned to be of comparatively long range, and no final conclusions can be drawn yet from the results obtained. A study of the fluctuations in density of *Antestia* populations, on plantations selected to give as wide a range of environmental conditions as possible, is being made. The density of the population on each plantation is determined by monthly test-spraying of a number of trees selected at random in a block set aside for the experiment, the block being left undisturbed as far as practicable. At the same time wherever possible, eggs are collected to determine the incidence of egg parasitism. The work must be continued before results can be expected. Study of the

bionomics of a number of egg parasites was begun and had proceeded considerably when I left for the United States. This phase of the work awaits completion on my return. The bionomics of *Antestia* itself have also been a subject of study, and among other phases this includes an investigation of the indigenous host plants, several of which have been discovered. A further subject of study that was begun and has continued uninterrupted up to the time of writing, is the influence of poison bait on various hymenopterous parasites of coffee pests. The subject has not yet reached a stage for publication.

An experimental study of each of the three chief control measures used against this insect has been undertaken. The data gathered on two of these (poison-baiting and kerosene-pyrethrum spraying) are not yet complete, but an experimental study of hand-picking which is the measure most widely adopted in Kenya has been completed.

The experimental work in connection with this investigation consisted in a number of hand-pickings in the field in which, of the total number of insects present, the percentages captured in known periods spent in the work were ascertained.

It was shown that as hand-picking continues there is a progressive increase in the time required to obtain equal percentages of insects. When the experimental results are plotted it is found that they are approximated closely by a curve of the exponential type, the formula for which may be expressed thus:—

$$P = 100 (1 - (v.e)^{-t})$$

where P represents the percentage hand-picked of the total *Antestia* present, " t " represents the time in hours of two boys to a tree, " e " is the base of the naperian logarithms, and " v " is a co-efficient varying with the efficiency of the labour under different conditions. In a purely theoretical case, assuming the searching of the handpickers to be random and their industry to be continued throughout without flagging this co-efficient is unity and the formula becomes $P = 100 (1 - e^{-t})$.

In practice one careful experimental hand-picking provides data for the calculation of the formula which may then be used to determine the cost of picking any percentage.

The results show that in theory 100 per cent of the insects can never be obtained, and that in practice the cost of picking an adequate percentage is almost invariably prohibitive. Detailed results of this and other work on the same subject are now in the press.

The experimental investigation of the kerosene-pyrethrum spraying method is not completed, but a number of improvements in the method have been suggested from time to time, and studies of results obtained by planters in actual practice with it have been made. A departmental bulletin giving recommendations on the application of the method was issued.

The poison-bait method of control also received some attention, but the study is not complete. Suggested alterations in the general recommendations, designed to suit the method more closely to Kenya conditions have been made from time to time.

A survey of the incidence of *Antestia* on coffee in Kenya in 1933 and part of 1934, and of the methods used by planters for its control was made by means of a questionnaire circulated to all coffee planters. A considerable amount of interesting information was thus obtained, a report on which was published. The chief control methods used during that period were hand-picking by 188 planters, poison-bait by 91 planters and pyrethrum-extract spraying by 53 planters.

White Borer (*Anthores leuconotus*).

Mr. Wilkinson reports as follows:—

A serious outbreak of *Anthores leuconotus* (white borer) took place on a coffee estate in Makuyu in April, and considerable alarm was expressed by coffee planters in Thika on account of the statements made that large numbers of these adult beetles were flying into the coffee from the adjacent bush. Mr. Knight inspected the area from 8th to 13th May, and as a result of his inspection I paid a visit to the area from 5th to 10th June. The evidence showed that the infestation was due to neglect of control measures in the past, and whilst the number of adult beetles caught could be more than accounted for by the number of emergence holes in the coffee, there was no evidence that any beetles had entered the coffee from the surrounding bush. Thus, although the original infestation must take place from the bush, this immigration is very small. Two trees containing larvae believed to be *Anthores* were found, one a *Canthium* and the second unidentified. These larvae are being brought to maturity for identification. During this work two native host plants of *Antestia* were found, and many records of other coffee insects on native hosts obtained.

A complete survey was then carried out by Mr. Knight, during June and July, who reported that the area affected

had not increased during the last five years and that whilst the measures recommended by the Department for control were effective where applied, a number of planters were failing to carry these out. As a result of this campaign, however, and a later inspection by Mr. Knight it would appear that the white borer situation is well in hand, though it will require careful watching. Mr. Wilkinson read a paper at the Coffee Planters' Days in July discussing the whole question, which was published in the *East African Standard* on August 9th.

Thrips on Coffee.

Mr. Notley reports :—

A serious outbreak of Thrips took place in the Ruiru district in March, despite heavy rain in February. An investigation was undertaken to determine the cause of *Thrips* outbreaks, and the conclusion arrived at was that this was not due to drought, as had previously been maintained, but to unusually high temperatures during the last few months of the year. An account of this work was given at the Coffee Planters' Days in July, and later published in the *East African Agricultural Journal*. This work makes possible a forecast of the probabilities of a Thrips outbreak in any year.

Phloeobius.

The larvae of *Phloeobius* species were found causing considerable damage to young coffee plants in a nursery near Donyo Sabuk during October. This attack had not been noticed until many of the plants began to wilt when inspection revealed a 3 per cent infection.

Maize Stalk Borer.

From the 24th May until the 17th June Mr. Wilkinson carried out an inspection of some one hundred maize farms and numerous squatter and native shambas in the Nakuru, Muhoroni, Solai, Sabukia, Olpunyata, Lower Molo, Rongai, Ravine, Elburgon, Londiani and Solai areas in connection with maize stalk borer, *Busseola fusca* Fuller. For various reasons the Stalk Borer Regulations have been held in abeyance for several years, but were again brought into operation during the year, when it was determined that all maize must be planted within the above areas before the 31st May. The result of the above inspection revealed that—

- (a) not more than about 1 per cent of the maize stalks were infected with stalk borer;

- (b) the earlier planted maize, February-March, was infected to a greater degree than the later planted maize on the same farms; this could be anticipated since the destruction of old maize stalks had not been complete towards the end of the previous season;
- (c) heavily infested maize stalks were standing in the field beside dumps of old maize stalks, which were to be utilized in the making of compost; it is worthy to note that in such cases Derrisol was being applied to the infested stalks and complete control of stalk borer obtained;
- (d) only one instance was found where maize had been planted after the 31st May, arrangements were made to destroy this crop and to replant the land with wheat.

What appeared at first sight to be a very disturbing feature was the discovery that Napier grass, *Pennisetum purpureum*, was infected with the larvae of *Busseola fusca*; on close investigation it was noticed that in no single instance had the stem of Napier grass been bored into and damage was confined to the outer leaves surrounding the growing point. From the position of the larvae it appeared that the adult moths had laid their eggs upon the leaves of Napier grass in a similar position to those laid on maize, and that on hatching, the young larvae fed for a time upon the young outer leaves of the grass and died before boring either into the funnel of the plant or into the main stem and were unable to complete their life cycle on this plant. Thus, it seemed that according as to whether the life history of this insect could or could not be completed on Napier grass the latter would be either a dangerous host, to be dealt with under the maize rules, or perhaps a useful trap crop and an asset to the whole maize community.

In order to determine these points twenty-four male and female moths of the stalk borer were allowed access to Napier grass growing in a cage in the open. Daily observations were made, but neither eggs nor larvae of these moths were discovered and all the moths died within seven days.

Larvae in various stages of development were then obtained from infested maize stalks and placed on the Napier grass in the above cage. After three days, only the larvae in the fourth instar stage were found to have bored into the

stem of the Napier grass and within seven days all younger and smaller larvae were found dead on the leaves. Of the larvae which bored into the stem all died before pupating. The results of these experiments being unsatisfactory, further experiments will be conducted when opportunity arises.

Waxy Scale—*Ceroplastes destructor*.

From August to October a visit was paid to Kenya by W. B. Gurney, Chief Entomologist, New South Wales, for purposes of obtaining and despatching to Australia parasites of *Ceroplastes destructor*. This visit was most fortunate in that it coincided with the discovery by Mr. Naismith Jones of an outbreak of waxy scale on coffee in the Limuru district. This outbreak, though not particularly serious, was more severe than any previously observed within the Colony and appears to have resulted from the frequent use of poison bait for the control of *Antestia*. The scale was found to be heavily parasitized by *Scutellista cyanea*, Mot; many specimens were obtained with little difficulty and three consignments were despatched by air mail to Australia where they were received in good condition. It is hoped that *Scutellista* may control *Ceroplastes destructor*, which is a major pest of citrus in New South Wales.

Mr. Gurney's visit is recorded with great pleasure for the knowledge he possesses of the insect pests of Australia is encyclopaedic and such knowledge was imparted with freedom during our many discussions.

Insecticides.

(a) Tests were carried out in the laboratory of an improved spray mixture submitted by a Kenya settler for the destruction of locusts. The result of these tests proved conclusively that the spray mixture as submitted was valueless and the claims made could not be substantiated in practice.

(b) *Pyrethrum Powder*.—Reports were received that Mr. W. G. Dawson, a coffee planter in Sotik, was obtaining successful results in the control of *Antestia* by using pyrethrum dust applied with a converted Sovereign pump.

As a result of these reports, biological tests were undertaken by Mr. Wilkinson, using *Antestia* and locally grown pyrethrum powder as a dust. Through the kind co-operation of the Senior Agricultural Chemist, the pyrethrum powder used in the experiments was tested for degree of fineness by Mr. McNaughtan, who supplied the following figures :—

A sample of the powder was oven-dried at 100° C. for a period of 24 hours and then passed through a series of sieves.

	<i>Per cent</i>
Did not pass through a sieve of 60 mesh per linear inch ..	1.4
Passed through a sieve of 60 mesh per linear inch, but not through one of 80 mesh	0.5
Passed through a sieve of 80 mesh per linear inch, but not through one of 100 mesh.. .. .	3.8
Passed through a sieve of 100 mesh per linear inch, but not through one of 120 mesh.. .. .	21.1
Passed through a sieve of 120 mesh per linear inch, but not through one of 150 mesh.. .. .	8.9
Passed through a sieve of 150 mesh per linear inch.. ..	64.3
TOTAL ..	<u>100.0</u>

Using pyrethrum powder of the above fineness various methods of evaluating biologically its toxicity were investigated, but no method has yet been found which can be said to be satisfactory. It would appear from experiments conducted that the merest trace of pyrethrum powder coming in contact with an *Antestia* bug causes paralysis and death of the insect; the amount is so small that it has not been found possible to measure it.

Using a total of 120 *Antestia* the average time taken for paralysis to set in, as determined by the behaviour of the hind legs, was 3 minutes 29½ seconds, with a maximum of 6 minutes 45 seconds, and a minimum of 1 minute 10 seconds for different individuals. All the dusted *Antestia* were kept under observation for a period of 48 hours, during which time there were no recoveries and all the 120 *Antestia* were dead. The time for paralysis to set in was taken owing to the difficulty of observing the time of death of each individual *Antestia* when using large numbers of the insect in one experiment.

These experiments, the technique of which is under investigation, indicate that the control of *Antestia* can be achieved by dusting infested trees with finely ground pyrethrum powder at the rate of not more than 4 grammes per tree or 6 lb. per acre of 680 trees. With this method of control it is not necessary to cover the trees with sheets and a slight breeze blowing at the time of dusting appears to be advantageous. The cost per acre of materials and application is much less than the cost of spraying with pyrethrum-paraffin extract as previously recommended by the Department (*see* Bulletin No.

8, 1934, by Dr. Le Pelley). Further experiments are necessary in order to determine the minimum quantity of powder which can be used per acre and to evolve a suitable technique.

ACKNOWLEDGMENTS.

I should like to place on record the thanks of the Section for the kind co-operation of the following in assisting this Department with information and the introduction of parasites of certain of our insect pests: Sir Guy Marshall, Director of the Imperial Institute of Entomology, London; Dr. Thompson, Director of Farnham House Laboratory; Director of the Experimental Station, Midden and Oost-Java, at Malang; Pro. Smith, Riverside Experimental Station, California; Mr. Fullaway, Entomologist, Honolulu; the Department of Agriculture, Tanganyika; the Department of Agriculture, Uganda; the East African Agricultural Research Station, Amani.

H. WILKINSON,
Entomologist.

Part V.—Provincial Reports

REPORT OF THE CENTRAL PROVINCE

The staff during the year was one Provincial officer and six district officers, the Provincial officer carrying out district work in South Nyeri in addition to his provincial duties.

AFRICAN STAFF.

The staff of Native Agricultural Instructors was as follows :—

DISTRICT	Department of Agriculture	Local Native Council	Total
South Nyeri	6	5	11
Fort Hall	9	8	17
Kiambu	7	6	13
Embu	16	4	20
Meru	6	4	10
Machakos	7	7	14
Kitui	7	7	14
TOTAL ..	58	41	99

The Provincial organization commenced in 1932 and fully reported on in the Annual Report for 1933, continued to prove of the greatest value in initiating schemes for development and in co-ordinating the work of agricultural development in the various districts.

AGRICULTURAL ZONES.

The native reserves of the Province cover an area of 13,470 square miles carrying a population of 1,182,000.

The Province is divided into five agricultural development zones, based mainly on climatic and soil conditions.

The first zone is situated on the upper slopes of the Aberdares and Mt. Kenya and embraces land over 6,000 ft. above sea level. The soil is a light loam which loses fertility rapidly under cultivation and is best suited to wattle production, wheat, dairying on Kikuyu grass and sheep farming. The zone extends to an area of 665 square miles and carries a population of 170,220.

Zones two and three are situated between elevations of 4,000 ft. and 6,000 ft. and cover an area of 2,890 square miles, with a population of 734,844. This is much the most densely

settled area of the Province and in certain parts the number of people per square mile exceeds 600. The soil is mostly a rich Kikuyu red loam, highly fertile, and conditions are suited to the cultivation of a wide variety of crops including maize, beans, potatoes, wattle and coffee.

The fourth and fifth zones are very sparsely populated and extend to an area of 9,933 square miles covering the lower parts of the Province. Large portions of the zones are "fly" infested and the whole area is subject to semi-drought conditions. A wide range of soil types are found, the darker soils being fertile and capable of supporting good crops of cotton, millets, sorghums, cassavas, cowpeas, etc.

The foregoing brief description of the conditions affecting agriculture in the Province will assist in an understanding of the report which follows.

SEASONAL CONDITIONS.

After the partial failure of the 1934 short rains, drought conditions obtained in the Machakos and Kitui districts and generally over the lower zones of the Province until November, when heavy rain fell everywhere. In the intermediate and higher zones the long rains commenced prematurely in February and during March and April only half of the average rainfall was obtained. In May and June, however, the rainfall was above average which enabled crops to carry through and provide a low average yield.

As a result of the drought, abnormally cold weather conditions were experienced in July and August in the lower areas, which retarded the growth of cotton plants and caused shedding of bolls in the November planted crop.

The short rains commenced in early November carrying on until the end of the year and giving promise of good crops everywhere.

DISEASES AND PESTS.

Diseases.

(a) *Maize*.—Owing to abnormal weather conditions a crop of maize was on the land continuously from October, 1934, to September of this year. The result was a serious increase in the incidence of streak disease. White blight was also prevalent in the wetter areas of the Province.

(b) *Wheat*.—It has not yet been possible to issue any of the rust-resistant wheat varieties to native reserves so that

Kenya Governor remains the only variety in cultivation. The crop was attacked by stem rust in December and it is feared will be a total loss.

(c) *Potatoes*.—An internal disease was prevalent in potato tubers, which awaits identification.

Pests.

(a) *Locusts*.—Swarms of red locusts were reported in all districts between April and November, but little damage was done to crops.

(b) *Cotton Stainers*.—These pests have been particularly troublesome and have caused severe losses. Indigenous host plants have been identified as species of *Vangueria*, *Malvaceae* and *Ceratonia*.

(c) *American Boll Worm*.—The presence of this pest in certain areas did considerable damage to the cotton crop.

LOCAL NATIVE COUNCIL SEED FARMS

DISTRICT	Seed Farm	Total Acreage	Acreage in Cultivation	Altitudes
				<i>Feet</i>
S. Nyeri ...	Nyeri	45	30.5	5,900
	Gichiche	8	8	6,800
Fort Hall ..	Fort Hall	60	70	4,400
Kiambu ..	Kamiti	100	50	
Embu ..	Embu	45	37	4,500
	Karogoya	10.2	10.2	5,000
	Meru	31	31	5,400
Meru ..	Oringo	16.5	16.5	4,800
	Chuka	6.5	6.5	5,000
	Machakos	50	45	5,300
Machakos ..	Masii	10	10	4,400
	Matiliku	6	6	3,600
Kitui ..	Ithokwe	25	25	3,860
	Ndolo	10	10	4,000

In the more advanced districts of Kiambu, Fort Hall, South Nyeri, Embu and Machakos there are a number of progressive native farmers with comparatively large acreages. Now varieties of seed grown on seed farms are issued to these farmers in the first place and the resultant crop is bought in by the Councils for re-issue. In this way rapid progress can be made in extending the cultivation of new and better varieties of seed.

The introduction of mixed farming methods is regarded as of the utmost importance in the more densely populated areas. The intention is that each seed farm should offer a

demonstration of this system and in particular of stall feeding and paddocking. At Nyeri and Fort Hall recorded cows are kept and different varieties of grasses have been planted in the paddocks.

Organized Demonstrations.

Parties of headmen, elders, pupils and others are taken round seed farms at frequent intervals and shown demonstrations of anti-soil erosion measures, compost making, the working of new implements, the hand rearing of calves, the preparation of beeswax, selection of seed and any new varieties of crops which promise to be of economic importance. Although these organized demonstrations have proved of great value in the dissemination of knowledge it is of greater interest to record the almost daily visits of individuals seeking advice in regard to crops and farming methods.

INVESTIGATIONAL WORK.

This is reported on by the Deputy Director.

NEW CROPS.

A number of new crops were introduced into the Province last year and after being bulked are now finding their way into general cultivation. These include cotton, groundnuts, and Victoria peas. The above mentioned are all cash crops and their widespread cultivation should greatly add to the prosperity of the reserves.

Ramie fibre was introduced early this year and the observational trials are promising. Material is now being bulked for issue as a yard crop. As already reported development programmes have been laid down covering the whole Province and all new crops of economic importance. The introduction into widespread cultivation of any new crop takes time and perseverance and it is felt that only crops of very outstanding importance should be imported until such time as results have been obtained with present programmes.

An outlet has been found for frankincense from Kitui district.

Seed Issues.

The distribution of improved strains of seed such as maize, liable to cross-fertilization, is undertaken location by location in rotation.

New crops are issued to selected natives in the first place who are being asked to return the seed for further issue after harvest.

Particulars of seed issues are shown in the following table. In addition small quantities of seed were provided by Government for trial.

SEED ISSUES

CROP	South Nyeri	Fort Hall	Kiambu	Embu	Meru	Machakos	Kitui	Total
FROM DEPARTMENTAL FUNDS								
Maize	—	76	—	—	—	—	43	119
Beans	—	—	17	10	—	10	—	37
Gram	—	—	—	—	—	10	—	10
Simsim	—	—	—	—	10	—	—	10
Groundnuts ..	—	—	—	—	6	—	—	6
Wattle	10	—	—	13	—	—	23	46
FROM LOCAL NATIVE COUNCIL FUNDS								
Beans	—	2	—	—	—	148	—	150
Gram	—	—	—	—	—	50	—	50
Potatoes	—	—	—	—	—	20	—	20
Cassava	—	—	—	—	—	5 tons	—	5 tons
Wattle	4	—	—	—	—	—	4	8
Napier Grass ..	—	—	5 tons	—	—	—	—	5 tons
FROM SEED FARMS								
Maize	135	149	—	125	94	330	—	833
Beans	47	2	12	35	19	2½	10	127½
Gram	—	—	—	—	2	3½	9	14½
Sorghums	—	4	—	3	2	7½	8½	25
Potatoes	165	—	17	134	33	—	—	349
Awned Bulrush								
Millet	—	3	—	21	16	—	—	40
Victoria Peas ..	12	3	—	—	—	—	—	15
Wheat	17	—	—	—	—	—	—	17
Napier Grass ..	15 tons	20 tons	—	—	15 tons	30 tons	—	80 tons
FROM GINNER								
Cotton Seed ..	—	2½ tons	—	12 tons	2 tons	—	25 tons	41½ tons

Unless otherwise stated, all quantities are in bags of 200 lb. each.

Issues of tree and fruit seedlings from nurseries were :—

Orange and lemon seedlings ... 1,259

Tree seedlings 45,000

IMPROVEMENT IN QUALITY OF PRODUCE.

The improvement in the quality of native produce generally has received a great deal of attention during the year with most gratifying results. By means of propaganda spread over a number of years the quality of produce had improved amongst the more advanced natives, but it was found

most difficult to collect a good clean bulk consignment of any crop, fit for export. In the Annual Report for this Province of 1934 mention was made of an endeavour to commence a system of voluntary central inspection of all exportable produce. This system of inspection was got under way in January.

PRODUCE INSPECTION.

The compulsory central inspection of wattle bark was continued during the year and a system of voluntary inspection of maize, beans, peas and potatoes was instituted in the districts of South Nyeri, Fort Hall, Embu and Meru.

Wattle Bark Inspection.

Late in 1933 the compulsory inspection of wattle bark was commenced in the districts of South Nyeri, Kiambu and Fort Hall. The objects of inspection were firstly to ensure a rapid and widespread improvement in the quality of bark and secondly to educate the producer up to the standard of bark required and so put an end to the wasteful cutting of immature trees. In order to achieve this educative value it was necessary to establish numerous inspection centres in the reserves so that actual producers themselves could be taught the standards required. Late in 1934 it was considered that the education of the producer had been achieved and all inspection centres were moved down to railway stations. The siting of these centres on rail paved the way for the organized marketing of wattle bark and also reduced the number and so the costs of the services provided.

Before inspection was commenced the quality of the bark was very poor, as was reflected in the prices offered for Kenya bark, namely Sh. 30 per ton below that offered for Natal bark. Last year the difference in price had been reduced to from Sh. 5 to Sh. 10 per ton and this year it is understood that quotations for Kenya and Natal bark are similar. Converting the improvement in quality as a direct result of inspection, into terms of hard cash one obtains the gratifying result of Sh. 25 to Sh. 30 per ton, and this result has been obtained in two years at a cost of 30 cents per ton.

The quantity of dry bark inspected per year varies from 12,000 to 14,000 tons. This quantity of bark passes through seven inspection centres.

The organized inspection of green bark, before delivery to extract factories, was commenced in November of this year.

Inspection of Maize, Legumes and Potatoes.

In these days of low market prices it has been found very necessary to improve and maintain the quality of the more important commodities, especially those of exportable value. It was realized that export markets existed for beans, maize, and potatoes which would readily absorb all the surplus native production, provided reasonable quality and true varieties in bulk could be obtained.

Although a number of natives were producing pure variety Rose Coco beans, for example, these were insufficient to make up an exportable consignment and the price obtainable was much the same as that for mixed beans.

The great majority of natives produced mixed beans for which there was only a small market, easily flooded. A similar situation existed in regard to maize and potatoes and very few buyers were prepared to take the risk of buying and exporting native produce in bulk consignments. Central inspection and the sorting and cleaning of these commodities before sale to buyers appeared to offer the solution to securing an outlet for surplus production and so obtaining a better price for the producer.

Government, however, were unwilling to make central inspection compulsory at that time and co-operation of the buyers was sought to institute a form of voluntary inspection. Although central inspection before sale was the system aimed at, agreement to this form could only be reached at Karatina in South Nyeri district. In other districts agreement was reached whereby bulk consignments were inspected before export from centres.

This latter system had the effect of safeguarding the large outside buyers against very poor quality, but no sorting of produce into pure varieties and grades could be carried out.

Central inspection, before sale to buyers, is obviously best suited to native conditions and market requirements and the effects of this system which has been in operation at Karatina during the year will be described. All produce is brought to an inspection shed where it is cleaned, sorted and picked over. After these operations are satisfactorily carried out the owner obtains a pass ticket and is at liberty to sell to any buyer.

Buyers agree to purchase only if produce is accompanied by an inspection pass ticket. Although, in the initial stages, some inconvenience was caused to producers and native sellers in picking over and cleaning their produce at the inspection

shed, the immediate results obtained were most satisfactory and central inspection has again proved itself to be the soundest and quickest method of raising the whole standard of native production. The benefits of inspection can best be shown by dealing with the crops handled, separately.

(a) *Maize.*

Large quantities of poor quality maize were reaching the market when inspection opened. This maize, owing to its poor quality, could only be sold locally and the market was flooded. Soon after inspection commenced large quantities were exported and there was a rise of 35 cents per bag. South Nyeri maize used to be the worst in the Province, as a result of inspection it is now the best and is graded as K3. 44,909 bags have been inspected at Karatina this year.

(b) *Beans.*

As already mentioned, the bulk of the bean crop produced in native reserves was of mixed varieties for which a very limited market existed. The sorting of beans into pure varieties was therefore commenced in August of this year. Samples brought in for inspection containing over 75 per cent of one variety are picked over until absolutely pure and receive an inspection pass ticket with the name of the variety. Samples containing under 75 per cent one variety are cleaned and receive a ticked "mixed" varieties. The price offered for pure varieties has ranged between Sh. 7/50 and Sh. 9 per bag while mixed varieties have fetched from Sh. 5 to Sh. 6 per bag. Before inspection all beans were classed as mixed, so that inspection is responsible for a high proportion of the bean crop fetching a price 50 per cent in excess of the price previously obtained. In addition, a good export market has been established for Karatina Rose Coco beans which has absorbed all the surplus production. 5,697 bags of this variety have been exported from the station since inspection commenced, that is, in four months.

(c) *Potatoes.*

Potatoes produced in South Nyeri are of good flavour and cooking quality, but no merchant would risk buying a consignment for export owing to mixed samples and the high percentage of damaged tubers and chats offered for sale. The quantities which could be absorbed in the local market were small. Inspection and sorting of potatoes was commenced in September and there was an immediate demand for the graded samples for export.

The price rose from Sh. 1/50 to Sh. 2/50 for graded samples accompanied by an inspection pass ticket. Since inspection commenced 2,428 bags have been exported and reports from Bombay are very satisfactory.

The results achieved by central inspection may be summarized as follows :—

(a) *Wattle*.—The improvement in quality has resulted in a rise in prices of between Sh. 25 and Sh. 30 per ton based on values compared with Natal bark before inspection commenced. In addition the demand for Kenya bark has improved.

(b) *Maize*.—The improvement in quality resulted in a rise in price of 35 cents per bag, and a market was found for the surplus production.

(c) *Beans*.—Before inspection was opened, bulk consignments of pure varieties could not be obtained and the demand for mixed beans was very limited. An export market for Rose Coco's has now been found which absorbs all surplus production coupled with a rise in price of 50 per cent to 75 per cent.

(d) *Potatoes*.—A new export market has been obtained for Karatina potatoes absorbing all surplus production with an increase in price of 50 per cent.

In view of the better prices offered for sorted samples natives, by the end of the year, were picking over all parcels however badly mixed.

The improvement in the quality of all produce was so marked that rules for the compulsory inspection of all produce have been made and will be brought into force on the 1st of January, 1936.

MARKETING.

Having, by means of inspection, found a ready outlet for produce the next step was to insure that the producer got the benefit of the increased prices offered. The number of native traders had increased to an alarming extent and the majority had little capital on which to carry on a legitimate business. They were buying all along the roads and paths and were working on the principle of a small turn-over and a large profit. Pending the putting into operation of the Marketing of Native Produce Ordinance most of the Local Native Councils passed resolutions forbidding the buying of produce within three miles of an established market. It was then found necessary to increase the number of markets and to assign each trader a plot in a market centre. These measures greatly

assisted the producer in obtaining a reasonable price for his produce. The limiting of the numbers of traders to those with sufficient capital enabled them to obtain a large turn-over and they therefore could work on a smaller profit. Until such time as the Marketing of Native Produce Ordinance comes into operation it will be impossible to enforce the proper organized marketing of produce in trading centres, townships and outside markets alike.

Local Native Council Marketing.

The Local Native Council marketing system reported on in 1933 continued in operation with Messrs. Gibson and Co., Ltd., as agents. The agents have again found it impossible to buy any large quantities of produce with the exception of wattle bark.

The following quantities of wattle bark have been purchased through the Local Native Council stores since 1932 when the scheme commenced :—

	1932	1933	1934	1935
Wattle Bark	503 tons	6,456 tons	6,222 tons	6,565 tons

Marketing, General.

The prices ruling for foodstuffs vary greatly with the distance from markets. The following average prices were offered :—

					Per 200 lb.			
					<i>Sh.</i>	<i>cts.</i>	<i>Sh.</i>	<i>cts.</i>
Beans, Rose Coco	..	..	..	..	7	50 to	9	00
Beans, Mixed	..	..	..	..	4	00 „	5	50
Pigeon Peas	..	..	..	..	5	00 „	7	00
Millet	..	..	..	..	4	00 „	7	50
Potatoes	..	..	..	..	3	00 „	6	00
Gram	..	..	..	..	12	00 „	16	00
Onions	..	..	..	..	12	00 „	15	00

A large proportion of foodstuffs is transported out of districts by road so that it is impossible to provide accurate figures of total quantities sold. Owing to drought conditions obtaining in Machakos and Kitui no produce was sold from the districts. The figures of quantities sold, given in the following table, relate therefore mainly to the Kikuyu districts of Kiambu, Fort Hall, Nyeri and Embu.

PRODUCE SOLD FROM RESERVES DURING 1935

Crop	S. Nyeri	Fort Hall	Kiambu	Embu	Meru	Machakos	Kitui	Total
Maize and Maize Meal (Bags)	73,909	113,702	94,000	70,700	2,000	—	—	354,311
Beans (Bags) ..	6,564	12,181	—	2,500	4,371	—	—	25,616
Wattle Bark, Dry (Tons) ..	3,098	6,272	3,725	36	—	—	—	13,131
Wattle Bark, Green (Tons) ..	—	7,303	1,132	—	—	—	—	8,435
Potatoes (Bags) ..	2,428	—	56,518	—	—	(No exports owing to drought)	—	58,946
Vegetables (Value) ..	—	—	Sh. 25,121	—	—	—	1,614	Sh. 25,121
Bees-wax (Frasilas) ..	5	33	10	—	—	—	153,211	1,662
Seed Cotton (Lb.) ..	—	13,484	—	11,521	1,828	—	—	*180,044
		(To date)	(No figures available)	(To date)	(To date)	(No figures available)		
Hides, Sun Dried (Frasilas) ..	83	1,244	ditto	1,866	870	—	1,750	—
Hides, Shade Dried (Frasilas) ..	1,767	2,488	ditto	—	—	—	7,350	—
Skins (Scores) ..	—	—	—	—	—	—	3,803	—

*At the time of the preparation of this Report this figure has exceeded 250,000 lb.

SOIL FERTILITY AND EROSION.

Loss of soil fertility caused by erosion and prolonged cultivation without manure is regarded as the most serious problem with which we have to contend.

Soil Fertility.

The solution to the problem is considered to be the small holding carrying a few cows, in milk. A great deal of propaganda has been carried out in an endeavour to get natives in the more densely populated areas to lay down steep land, unfit for cultivation, to permanent grazing and to plant up small areas, near the villages, to Napier grass. The aim is to get each family to keep cows in milk on the holding and to send dry cows and bullocks out to the communal grazing areas. In this way manure will be available for the land. It is gratifying to record that there are now 422 natives with fenced in paddocks and that more than double this number have planted grasses preparatory to fencing. In addition over 900 natives have planted Napier grass for the stall feeding of cows. Every opportunity has been taken to impress on the people the value of organic manuring and after many years of slow progress there has been a sudden and widespread movement towards manuring the land. Many cases are recorded of more advanced natives actually buying manure from their less enlightened neighbours.

Compost pit campaigns have been under way and the number of pits now in operation are as follows:—

<i>District</i>	<i>Pits in use.</i>
South Nyeri	8,065
Fort Hall	1,474
Kiambu	1,276
Embu	31,497

Erosion.

The topography of the greater part of the Province is hilly and broken and much of the steep land is necessarily under cultivation leading to severe soil erosion. It is anticipated that new powers will be vested in headmen in the near future enabling them to give orders for the control of erosion. Such orders will include Mangum broad base terracing, bench terracing, the planting of strips of Napier grass along contours, the laying down of steep land to permanent grazing and forest and the protection of the banks of watercourses and gullies.

During the year under review much progress is to be recorded in the planting of steep slopes to grasses and wattle

and in the planting of Napier grass along contours. The laying of trash across slopes is now common practice.

Reconditioning.

The two reconditioning demonstrations laid down in Machakos in 1933 and described in the Report for last year have provided valuable data on which large scale operations can be based. It is now possible to state that, by stagger-trenching and planting to *Cynodon* sp., denuded land will be capable of supporting stock in two years. Land which is stagger-trenched only will be ready to carry stock in three and a half years, while land which is only destocked will be fit to carry stock in five years.

A Reconditioning Officer was appointed by the Machakos Local Native Council early in the year and a few hundred acres have been tackled under his direction. Numerous new methods were tried by this officer which unfortunately were not entirely satisfactory. A Reconditioning Committee was therefore appointed by the Provincial Commissioner in November, whose duty it was to draw up and co-ordinate a long-range policy for the future reconditioning of the reserve. This committee met for the first time in December and will report early in 1936.

The reconditioning of the reserve is a big undertaking, but there is no reason why the work should not go ahead quickly now that suitable methods have been found. The chief need is adequate supervision.

A fodder tree arboretum was established at the Veterinary Quarantine Station at Machakos in 1934 which, it is hoped, will provide useful information. Severe drought conditions have been experienced and the trees which have survived are—

Brachychiton rupestra, *Phytolacca diocia*, *Disperma trachyphyllus* and *Atriplex numularia*.

NATIVE AGRICULTURAL TRAINING.

The training school for instructors for the Province is situated at the Scott Agricultural Laboratories and is reported on separately by the Deputy Director.

As a result of the push for better instruction in agricultural subjects at schools, far greater interest has been taken in this subject by missionaries and teachers.

MEASURES TAKEN TO PREVENT FAMINES.

Measures which have been taken for the prevention of famines apply mainly to the Machakos and Kitui districts and to the lower parts of Fort Hall, Embu and Meru districts.

*A.—Crop Introduction and Trials.**Sorghums.*

The native varieties of sorghums take approximately ten months to mature, so that the growing period extends through both the long and short rainy seasons. These varieties are therefore dependent on two seasons of rain and the failure of one causes the loss of the crop. The aim has therefore been to obtain a variety which matures in five to six months.

In all, twelve imported varieties have been under trial and, of these, Sunrise Kafir (a sweet variety) and Bonganhilo (a bitter variety) have been selected for bulking and distribution in the Kikuyu and Ukamba areas respectively. Both of these varieties mature in four to five months.

Maize.

Four drought-resistant varieties have been under trial and of these Muratha (the Departmental selection) has proved one of the highest yielders in all areas. This variety has the further advantage of being grown throughout the intermediate zones of the Province and can therefore be purchased in bulk for the lower areas. The crop matures in these low zones in four and a half months.

Millets.

Four varieties of millets have been under trial in all districts and of these the Tanganyika Awned Bulrush is the most promising and is being bulked for issue on all seed farms. This variety is the most popular of all recent introduction and the demand for seed is enormous. The yield is three times greater than that obtained from the native variety and the awned character greatly reduces the damage by birds. The crop matures in from three to four and a half months.

Legumes.

Tepary bean, Morogoro Cowpea, Black Gram and Green Gram have all yielded well under trial. The Tepary bean has a slightly bitter flavour if not soaked over-night before cooking. These crops mature in from two and a half to three and a half months.

Cassava.

Efforts have been made to select a variety resistant to Mosaic disease and this has met with success. The planting of this crop is regarded as the best form of insurance against famines.

Cotton.

Ample proof has been afforded in Kitui during the past year that cotton will mature a crop under conditions of rainfall insufficient to provide a harvest from the local food crops, so that cotton must be regarded as a famine prevention crop. Planting date and variety trials were carried out in 1933 and 1934 and these proved successful.

B.—Extent to which the Crops discussed are under Cultivation.

As already mentioned the work carried out on the introduction of drought-resistant crops has been mainly of an experimental nature. Trials have now, however, been completed and the crops mentioned are being bulked for issue on all available seed farms.

The following acreages were planted to drought-resistant food crops in October, 1934, by natives in the famine areas :—

CROP	District	Acreages
		<i>Acres</i>
(1) Sorghums, Sunrise	Embu ..	10
	Fort Hall ..	10
Sorghums, Bonganhilo	Kitui ..	43
	Machakos ..	15
(2) Maize, Muratha	Machakos ..	2,000
	Fort Hall ..	500
	Embu ..	1,000
	Kitui ..	435
	Meru ..	100
(3) Millets, Tanganyika Awned Bulrush	Embu ..	34
	Kitui ..	4
	Fort Hall ..	5
	Meru ..	10
	Machakos ..	15
	Nyeri ..	20
(4) Legumes—		
Green Gram	Machakos ..	1,000
Green Gram	Kitui ..	10
Black Gram	Kitui ..	2
Cowpea, Morogoro	Kitui ..	25
Tepary Bean	Kitui ..	35
(5) Cotton (U/4)	Kitui ..	4,040
Cotton (Uganda)	Machakos ..	1,000
	Embu ..	1,200
	Meru ..	180
	Fort Hall ..	120

(6) Cassava—

A campaign was instituted in 1935 to get each family, throughout the famine areas of the Province, to plant half an acre to Cassava.

Twenty-five blocks of land were opened in the lower areas for the bulking of cassava sets for planting. Figures are not yet available of the acreage planted by individuals, but all available sets have been issued. It is anticipated that by April 1937 each family in the famine areas will have half an acre planted to this crop, which will cover approximately 40,000 acres.

C.—General.

During the past three years severe conditions of drought have been experienced in the lower parts of the Province and during this period £7,770 has been spent by Local Native Councils on famine relief. Under the present working of the Native Authority Ordinance, section 15, it is impossible to take measures to prevent famine until a shortage of food actually exists. As the shortage of food is caused by the prevailing drought, any orders given to plant certain crops in certain areas cannot usefully be carried out. When this section of the Ordinance has been amended, as recommended by the Provincial Commissioners, it will be possible to take measures for the prevention of famines before they occur. This amendment would enable us to insure that each village had sufficient drought-resistant crops planted to carry the people over any ordinary drought period.

Whenever possible swamps have been drained and the natives have been settled in the country surrounding such fertile drained land. This later work alone has gone a long way towards preventing famines in Lower Embu, Fort Hall and South Nyeri districts.

Any report on famine prevention would not be complete without mentioning the fundamental principles of soil cultivation and moisture conservation. The peoples living in these famine areas are extremely indolent and the land is seldom cultivated properly, with the result that a hard baked crust forms on the surface. A great deal of propaganda and push has been necessary during the past three years to get the people to buy hoes and to carry out periodic cultivation. Without such preliminary work the issue of drought crops is of little value.

From the foregoing it will be realized that famines will be prevented in the drier areas of the Province, either slowly through propaganda and the introduction of drought resistant crops, or immediately through powers enabling district commissioners to order the planting each year of a sufficient acreage of the crops recommended above.

GENERAL.

Good average crops were harvested during both seasons in the intermediate zones of the Province. According to reports received from maize buyers, there was a record crop of over 450,000 bags sold from the Kikuyu Reserves, but this is thought to be too high a figure. The heavy surplus was due to better methods of cultivation and to the improved yielding capacity of seed planted. Over the lower parts of the Province conditions of drought were experienced, and in Kitui famine was severe.

Cotton.

The final computation of the acreage planted to cotton in Kitui district in November, 1934, was approximately 1,700 acres. As already stated elsewhere, severe drought conditions were experienced and crop yields were seriously affected. A total of 153,211 lb. of seed cotton was sold, natives receiving approximately Sh. 15,321. The Ginnery at Kitui was formally opened in September. In November, 1935, 4,000 acres were planted and crop prospects are bright.

A cotton campaign was opened in Lower Embu, Fort Hall and Meru districts in February and the following acreages were planted up in April:—

Embu	1,000 acres
Meru	150 acres
Fort Hall	178 acres

Here again the crop was badly droughted, most of the cotton receiving only $2\frac{1}{2}$ inches of rain between the time of planting and August. The drought was followed by abnormally cold conditions in July and August which caused the shedding of bolls. Total figures of yields are not yet available but those from block planting in Embu district are likely to be very light. The returns from certain individual shambas in Fort Hall and Meru have been encouraging, as much as Sh. 60 having been obtained from one acre.

Campaigns were under way at the end of the year for increased production. It is anticipated that the acreages under cotton in 1936 will be:—

Machakos	2,500 acres
Fort Hall	800 acres
Embu	4,500 acres
Meru	4,200 acres

The total for the Province including the 4,000 acres at Kitui will therefore be in the neighbourhood of 16,000 acres.

A further large ginnery is nearing completion at Sagana.

Natives are most conservative in their ideas and it will be some years before they become really keen on cotton and give it the proper attention it requires, to obtain the best results. It is the only cash crop suited to the lower zones of the Province and will therefore eventually fill a most important place in the development of the reserves and in drawing people down from the thickly populated higher zones.

Coffee.

Coffee nurseries were established at Embu and Meru early in 1934 and seedlings were planted out into individual shambas in March and November of this year. Plantings have been confined to small demarcated areas and great difficulties have been experienced by renters in obtaining land from right-holders within these small areas. In Meru $27\frac{1}{2}$ acres have been planted out and in Embu $19\frac{1}{4}$ acres. Until such time as more extended areas are permitted for native coffee growing progress will be slow. All coffee is being grown on the Agobiada system to provide for easy pruning in later years.

A coffee variety trial was laid down at Meru and planted to Kents (Tanganyika), Kents (Ceylon), Blue Mountain and Harar.

A small quantity of Robusta seed was obtained for Meru, which will be planted out in the hot humid area of that district.

Beans.

A healthy export of Rose Coco beans was commenced from South Nyeri district, as a result of inspection. Owing to the high price obtained for these inspected beans the acreage under this crop will be increased and it is believed 50,000 bags should be available for export in 1936. In order to avoid flooding the market, different varieties of beans have been selected for different districts. The varieties include Rose Coco, Canadian Wonder, Painted Lady, and Boston Whites.

Wattle.

Throughout the higher zones of the Province wattle is much the most economic crop for natives. Campaigns have been under way in Kiambu, Fort Hall, South Nyeri, Embu and Machakos districts for increased acreages to be planted to

this crop. It is estimated that the area under wattle has increased from 45,000 acres in 1934 to close on 100,000 acres at the end of this year. It is intended that an additional 50,000 acres should be planted by 1937.

The quality of the bark is now first class and the demand is good. The price of dry bark rose by Sh. 9 per ton.

Maize.

The quality of native maize has improved enormously since inspection was commenced and it is now confidently expected that South Nyeri and Fort Hall districts will be able to export K3 quality in 1936.

Potatoes.

Large quantities of potatoes are produced in Kiambu and South Nyeri districts and with inspection a ready outlet should be found for the crop. One exporter has already contracted to supply 90 tons of South Nyeri potatoes to Bombay in 1936.

Hides and Skins.

Chains of Local Native Council shade-drying sheds are now in operation in the Machakos, Kitui and Meru districts. Similar chains of sheds are in operation in Kiambu, Fort Hall, South Nyeri and Embu districts where a more advanced stage has been reached and the sheds are individually owned and managed. The great majority of hides in the more advanced districts are now shade-dried, a 40 per cent premium being obtained over the sun-dried article.

Live Stock.

Donkeys continue to increase in numbers and are proving most useful animals for pack transport purposes. The number of cows being kept in the arable areas is reported as multiplying. No serious outbreaks of disease have taken place this year and large numbers of cattle have been sold to Somalis for export to Italian Somaliland.

Poultry.

The issue of Local Native Council pullets and cockerels continues to give good results, and breeding pens are established at Nyeri, Fort Hall, Kiambu, Embu, Meru and Machakos.

Ghee.

Demonstrations on ghee-making are given at Nyeri and Fort Hall seed farms and at Machakos by the Division of Animal Industry. Two factories were opened and equipped by private enterprise in Embu district.

Bees-wax.

The main beeswax-producing area is in the Kitui district. A large decrease in the amount of beeswax produced is shown, which is believed to be due to drought and subsequent poor flowering of honey-producing vegetation.

Efforts to encourage the proper preparation of bees-wax and the introduction of Queen excluder beehives is meeting with fair success. In certain districts the hanging of beehives is quite a ritual and the box type of hive does not appeal to the old men. A tremendous amount of work will be necessary before natives in the main producing areas can be induced to utilize excluder hives and it is considered that the quickest progress will be made by bringing bees-wax under the Agricultural Produce Inspection Rules.

Swamp Drainage.

The Local Native Councils of South Nyeri and Fort Hall passed resolutions for the upkeep of drained swamp land. In all approximately 8,000 acres have been drained. The soil in these drained swamps is very rich and supports excellent crops of roots. A native in South Nyeri has four acres of land in one of these swamps from which he obtained three crops of green peas per year.

Implements.

A large part of the Kikuyu country is too hilly for the use of draught implements and the system of land tenure with its small fragmented shambas also militates against their use. In certain parts of the Machakos district ploughs are greatly in demand and over 600 have been sold in the past few years. The danger is that natives will plough more land than they can properly manage with resultant lower mean yields and soil erosion. A small type of Hindustan plough introduced by the Department drawn by two oxen is likely to become popular.

In Kitui district much propaganda has been necessary to induce natives to use hoes and to cultivate their shambas properly. It is encouraging to note that over 8,000 hoes were purchased from the ginnery owner during the year.

Vermin.

Campaigns have been in operation for the extermination of porcupine, wild pig and hyaena in all districts and large numbers of vermin have been killed.

CONCLUSION.

This year (1935) is generally regarded as one of outstanding progress in agriculture in the native reserves of this Province. The trouble taken in organizing inspectional services and marketing has been well repaid and the results achieved have proved beyond doubt that, once the quality of produce has been improved, the difficulties of surplus production largely disappear.

The whole basis of increasing production must depend on outlet for the produce and an outlet is largely contingent upon a supply of a standard quality article at competitive prices. Cotton has been introduced as a cash crop into the lower zones of the Province and its effect in a few years time should be far reaching. The acreage under wattle has been almost doubled in two years and the production of 350,000 bags of maize is 100,000 bags in excess of the previous record crop. A market has been opened for pure variety inspected beans and it is believed that in 1936 South Nyeri natives will be able to pay the whole of their tax out of one acre of beans per family in one season. The progress made has been remarkable and in this connection it is of interest to quote an extract from a letter received from the Superintendent of the Church of Scotland Mission at Tumutumu.

“In estimating the economic progress of the South Nyeri district, the following approximate figures of native contributions to services organized by us on their behalf may be of interest. Total, £1,268.

These figures represent a sharp rise on any previous efforts—corresponding figures for last year being about £700—£800. We ascribe the improvement (1) to the improved opportunities of finding work for wages outside the district and (2) to the improved prices and better marketing conditions available throughout the district and particularly at Karatina. The second factor is much the more important of the two.”

MAIN WORK IN HAND FOR 1936.

Programmes of work for each district and agricultural zone have been prepared, as is the practice each year, and the development of each reserve is organized. In addition to maintaining the activities already in operation the following work will be carried out and extended.

Soil Fertility.

- (1) Mixed farming holdings.
- (2) Village compost pits.

Soil Erosion.

- (1) The reconditioning of extensive areas in Machakos and the control of grazing.
- (2) Laying down of steep hillsides to trees and grasses.
- (3) Napier grass wash stops.
- (4) Mangum broad base terraces.

Wattle.

To continue the campaign to complete an additional 100,000 acres under wattle.

Beans.

To increase the cultivation of pure varieties for export.

Coffee.

To plant up a maximum of 100 acres in each of the defined areas in Embu and Meru districts.

Cotton.

To increase the area under this crop to 16,000 acres. To control the ravages of the cotton stainer.

Marketing.

To get the Marketing of Native Produce Ordinance and Rules into operation.

Inspection of Produce.

To extend the system of central inspection to all districts.

Swamp Drainage.

To complete the drainage of all swamp land.

ACKNOWLEDGMENTS.

In concluding this report the writer would acknowledge the support, zeal and hard work of all District Agricultural Officers and the whole-hearted help of the Administration. Without this help the progress reported on could not have been achieved.

W. G. LECKIE,
Provincial Agricultural Officer,
Central Province.

REPORT OF THE NYANZA PROVINCE

EUROPEAN STAFF.

This includes one Provincial and five district officers, including one in charge of Bukura Training School. The Provincial officer also gives attention to the Kano area of Central Kavirondo for district work.

AFRICAN STAFF.

The staff of Native Agricultural Instructors was as follows:—

	Depart- ment of Agriculture	Local Native Council	Ginnery	Total
Provincial	1	—	—	1
North Kavirondo ..	7	20	8	35
Central Kavirondo ..	9	14	10	33
South Kavirondo ..	7	18	2	27
Bukura	4	—	—	4
TOTAL ..	28	52	20	100

Varying large staffs of labourers, plantation inspectors, tree nursery foremen and labourers were employed in the districts supported in the main by Local Native Council votes. An interesting and successful innovation was the employment of produce inspectors for a voluntary system of central inspection in Central Kavirondo, who were paid by Indian traders themselves.

SEASONAL CONDITIONS.

Rainfall generally has been adequate although somewhat below average in parts. The long rains broke early in February, but were followed by a general dry spell in March, which caused a set back to crops in the lower areas. For the remainder of the year rainfall in the highlands was good, although accompanied by severe gales in May and June and the usual hail storms later in the year.

During the middle of the year in the lower country, a second dry spell, which amounted to a forty-day drought in parts of North Kavirondo, caused a setback to growing crops and delayed the usual July cotton plantings. In general the short rains in the lower country were adequate, but very variable locally.

RAINFALL AT CERTAIN CENTRES

PLACE	Rainfall, 1935	Average	Number of Years
Kakamega	76.79	76.63	13
Mumias	76.63	80.11	3
Malakisi	43.45	47.04	2
Maseno	58.77	55.66	2
Bukura	66.62	61.53	12
Kisumu	47.96	44.58	32
Kisii	53.22	63.45	10

AGRICULTURAL ZONES.

Each of the three Kavirondo districts is divided, according to the climatic conditions and the habits of the inhabitants, into agricultural zones. Development in each district follows definite lines for each zone, and is related to the crops grown, the crops considered suitable for introduction and the systems of farming suitable for the several zone conditions. At the beginning of each year a provincial programme of development work is drawn up in discussion between agricultural and administrative officers and receives the approval of the Provincial Commissioner, thus ensuring continuity throughout the districts.

The zone divisions are based generally upon the following main crops or main types of agriculture: cotton, cereals and pulses with little or no stock, intermediate crop cultivation with stock, both highland and lowland, and pure stock country. These divisions are to a certain extent elastic and the development of recent years shows that cotton, for instance, can be grown successfully in both the intermediate crop areas and the stock areas, and groundnuts can similarly be grown in both the intermediate crop areas and the cotton areas. Modifications with a tendency to broadening the outlines are thus seen to be needed in the system, which has, however, served a very useful purpose, and whose principles have been found to be basic.

CROP SURVEY.

Cotton.

During the year cotton growing was greatly extended throughout the lower parts of the Province.

In general the altitude of 4,600 feet was taken as the ceiling for cotton, but this is by no means a hard and fast limit. Until a few years ago cotton was grown only in the western parts of North and Central Kavirondo district, that

is, in the Uganda border area. It has now been introduced or reintroduced into practically all suitable parts of the three Kavirondo districts, except some otherwise suitable parts of South Kavirondo which are at present depopulated by sleeping sickness. In view of the extension, and of the somewhat different conditions and seasons through the three districts, it is now convenient to divide the cotton area into three, as follows :—

No. 1 Area.—North of the River Nzoia.

No. 2 Area.—Between the River Nzoia and the southern boundary of Central Kavirondo district.

No. 3 Area.—South Kavirondo district.

The following figures indicate the rapid progress made with cotton over the last five years :—

<i>Crop</i>	<i>lb.</i>
1930-31	918,967
1931-32	2,166,352
1932-33	3,940,764
1933-34	6,499,244
1934-35	9,401,231
1935-36	15,701,756

1935-36 *Crop* :—

No. 1 Area.—For the first time there was enthusiasm in this area regarding cotton planting. The acreage prepared and planted was very much greater than last year, both in the old-established area and in the newer trial areas. This enthusiasm was much greater than was expected and slow seed issues held up planting in some areas, the delay being aggravated by the prolonged drought. A survey over the five main cotton-producing locations in September showed an average acreage of one acre per family, of which most was planted in July and August, some also in June and a small part in September. The standard of cultivation has been very high; most of the fields have been planted more or less accurately in lines, although spacing still tends to be too wide, and there is still considerable wastage of seed in planting. The southernmost part of this area is planted early and the buying season opened in October at three stores.

No. 2 Area.—Vigorous efforts were made in this area to extend cotton growing and to increase production. Those locations which had grown it in the past were stimulated to do better and the crop was introduced with marked success into further new locations. The eastern end of this area was

allotted to the newly erected Kibos ginnery, which was officially opened on 1st December, 1935, by Sir Alan Pim. The western end of the area is being developed by Sio ginnery with the help of Kendu ginnery (under the same management) until such time as it is considered that a new ginnery in the area would be justified. Picking throughout the area started in October and buying was general by the end of the month, although the higher parts of the western half are a month later than the lake shore and plains. The results of the efforts have been good beyond all expectation, and while there is much to be done to consolidate the position, there is no doubt that cotton can and will be successfully grown in most of this area.

No. 3 Area.—In this area again there are two parts, the lower earlier lake and gulf shore areas and the upper later inland areas. The group plantation method, which was so successful last year in bringing the importance of cotton cultivation home to the somewhat more backward tribes of this area, was successfully continued this year, together with a certain amount of private cultivation, and an intensive production campaign resulted in a greatly increased acreage and crop. A peculiar season produced a small first crop followed by a good second crop.

COTTON BUYING FIGURES, 1935-6

(000's OMITTED)

DISTRICT	Quality	AREA			Total
		No. 1	No. 2	No. 3	
	'000 lb.	'000 lb.	'000 lb.	'000 lb.	'000 lb.
North Kavirondo ..	A	6,354	70	—	6,424
	B	539	14	—	553
Total ..		6,893	84	—	6,977
Central Kavirondo ..	A	3,799	1,306	—	5,105
	B	512	473	—	985
Total ..		4,311	1,779	—	6,090
South Kavirondo ..	A	—	—	1,971	1,971
	B	—	—	737	737
Total ..		—	—	2,708	2,708
TOTALS ..	A	10,153	1,376	1,971	13,500
	B	1,051	487	737	2,275
TOTAL ..		11,204	1,863	2,708	15,775

The total quantities of seed cotton for the three areas and the grand total are equivalent approximately to the following numbers of bales of ginned cotton :—

No. 1 Area	...	...	...	8,400 bales
No. 2 Area	...	...	...	1,400 bales
No. 3 Area	...	...	...	2,030 bales
Total of 3 Areas				11,830 bales

This shows an increase of 61 per cent in the last season over the previous one. The increase over the season 1933-34, when the production reached 5,690 bales, was 160 per cent.

Trials were made in various places with interplanted groundnuts; no promising results were obtained and further trials are to be made. In several areas also, cultivators were urged; when the cotton planting season had passed, to sow legumes for food in the blanks in the cotton fields, a measure that was attended with some success.

Ginneries.—The erection and opening of the Kibos ginnery, at the Kibos Flour and Oil Mills, has been noted above. Kendu ginnery, opened last year, is having a second very successful season. In the No. 1 area, Malakisi and Sio ginneries were extensively enlarged and remodelled and some Whitworth Middleton double roller gins were installed with great success. Malakisi ginnery in particular is now a very fine factory.

At the request of Government, ginneries in No. 1 area made attempts to put their established buying stores into better order and many of them have been cemented made rat-proof. This improvement will be extended as circumstances permit throughout all areas.

Groundnuts.

In the main producing areas of South Kavirondo, the 1934 cotton campaign caused a setback in the groundnut industry. During 1935 special efforts were made to restore this industry to its rightful place and these efforts were attended with great success, the crop increasing from 179 tons in 1934 to 522 tons in 1935. The price was better, averaging Sh. 3 per 36 lb., compared with Sh. 2/50 in 1934. The quality is excellent, due to a large extent to a system of inspection, and the usual samples are bold, smooth skinned and of a good colour and compare favourably with those grown elsewhere.

In North and Central Kavirondo this crop is of little importance so far, although extensive trials indicate that much of the soil and climate is suited to it. Seed issues have been made in some locations, but in spite of great efforts the crop is not yet viewed with favour.

At present all groundnuts grown are of the creeping variety; next year bunch groundnuts will be introduced, particularly with a view to interplanting trials with cotton.

Simsim.

The 1934-35 crop showed a slight increase in South Kavirondo over the previous season and good quality crops were reaped. In North Kavirondo the crop showed a serious decline owing to the low prices. Efforts were made to check this decline and a considerably increased acreage has been planted in the 1935-36 season, some of which has replaced the unremunerative surplus maize production. The season in North Kavirondo is excellent and good harvests are being reaped, while in South Kavirondo the reverse is the case. Steady production is being maintained in the western part of Central Kavirondo, but in the Kano Plains, floods and the uncertain season resulted in a reduction in acreage.

Maize.

Increased activity in mining has provided a strong local demand for maize in all three districts, and in South Kavirondo has enabled the price to remain at a reasonable level. In North Kavirondo, the long rains' plantings showed an increase over those of the previous year in the central and south locations, but not in the northern parts, which will be dealt with below. These increases coupled with a general improvement in quality are partly due to the systematic seed issues from the Kakamega Seed Farm and Bukura School. The seed issued is mostly Muratha or a Muratha-flat white cross, and the former has also been issued from Maseno Seed Farm.

The short rains' crop was planted under favourable conditions in the central locations of North Kavirondo, but in the southern locations and in Central Kavirondo the season was poor, and yields are expected to be low.

The 1934-35 harvest in the Kimilili area (North Kitosh in North Kavirondo), where maize is grown on a comparatively large scale by native "companies" using large ox-drawn imple-

ments, was a record one. The following figures show the development of this crop during the last three years in this area :—

<i>Crop.</i>	<i>No of Bags Railed from Broderick Falls Station.</i>				
1932-33	...	...	...	...	4,600
1933-34	...	...	...	...	10,800
1934-35	...	...	...	...	23,520

The quality of this maize is mostly of K2 standard. Most of the 1934-35 crop was sold at prices ranging from Sh. 1/50 to Sh. 3 per bag on the farm, and with the steadily falling prices Indian traders found themselves with large stocks of maize on their hands; and the result was that a small part of this crop yet remains unsold. The severe drop in maize prices at the selling time which is the planting time for the next season resulted in there being no increase in acreage for the 1935-36 crop.

Rice.

The rice crop is steadily gaining ground in North and Central Kavirondo. A fairly extensive reintroduction of "Mumias" rice into Wamia location in North Kavirondo was attended with success and most of the harvest is being retained for seed purposes. The nursery and transplanting system is not popular there, as the rice which was previously grown a decade ago was sown broadcast, and a habit once adopted is hard to change. The Mumias growers, mostly a Swahili settlement, sold 150 bags; Sh. 14 per bag for unhulled rice was the prevailing price, but many preferred to hand-hull their rice and sell it at Sh. 24 to Sh. 28 per bag.

Considerable success is being obtained in attempts to introduce Mwanza Sena rice in the Kano swamps and in swampy areas on the gulf shore in Central Kavirondo. The nursery and transplant system is being used.

Coffee.

Arabica coffee is confined to 45 acres of grouped privately-owned trial plantations in the highlands of Kisii. A further 15 acres is ready for planting and two new nurseries have been started.

A Robusta coffee nursery was started in each of the three Kavirondo district, selected seed from N'ganda (spreading) trees in Sese Islands, Uganda, being used.

Tobacco.

The fire-cured tobacco industry, using western dark nyasa seed, was extended in the Butere area of North Kavirondo. A trial long rains' planting was more successful than the main later crop, which suffered severe hail damage. Picking was completed by November, and the crop is larger than last year. No buying took place until 1936.

Trees.

Extended tree planting campaigns of both potted seedlings from nurseries and seeds of ant-resistant trees and black wattle were again carried out with good results. The work of the last few years is now bearing fruit in the numerous clumps of young trees which are very noticeable throughout the Province. The development of privately-owned tree nurseries, which is urged, is not proceeding as rapidly as could be wished. Black wattle planting campaigns were carried out in Serem, where North and Central Kavirondo and Nandi meet, the Kisii highlands and part of the South Lumbwa highlands. To help with the latter work, an officer was posted to Kericho during part of the year. Pleasing results are being obtained in all three areas, although it is difficult to develop the idea in the growers' minds of planting trees in plantations, instead of in little clumps or borders as is usual with the firewood supplies.

Food and Other Crops.

(i) *Wimbi* (*Eleusine* millet).—Average crops were obtained throughout the Province. In South Kavirondo a light red variety is of importance as an export crop to Tanganyika; it sold at Sh. 4 to Sh. 5 per bag. For internal consumption the Bukura variety, selected from Kisii early red (dark red) is being pushed and is becoming increasingly popular. Its importance in the main cotton area is that its earliness permits the planting of cotton after the wimbi harvest.

(ii) *Sorghum*.—Good crops were obtained. The new selected early varieties Dobbs and Kano are increasing in popularity.

(iii) *Pulses*.—The bean crop in North and Central Kavirondo was good, but a marked decline in exports was recorded in South Kavirondo, the 1934 exports being 226 tons and the 1935, 58 tons. Excellent crops of green gram were obtained, and the use of this crop as a catch crop in cotton was successfully tried. The tepary bean is meeting with success in the dry areas.

(iv) *Roots*.—The acreage of sweet potatoes and cassava steadily increases, but there is considerable room for more cassava.

(v) *Vegetables* for food and for sale to towns and mines steadily increase. The free issue of seeds has been stopped and although as a result fewer seeds are issued (on payment) it is certain that better results are being obtained.

FAMINE PREVENTION.

Measures taken for the prevention of famine may be divided into the following categories :—

(a) *Increased Planting of Existing Famine Crops.*

Native remember the famine conditions of a few years ago and they now realize the importance of increasing the acreages of existing famine-proof crops, such as cassava, sweet potatoes and bananas. Increased planting of these crops has been continually urged. Banana suckers are to be issued from Maseno Seed Farm. The increase in the planting of roots is satisfactory.

(b) *Introduction, trial, bulking and Issue and New Drought-Resistant Crops Propaganda.*

Certain new crops have been tested with a view to bulking and distribution of those most suitable.

(1) *Tepary beans*.—Introduced in 1935 and tried at the Malakisi plot, these beans have proved successful and matured in from eight to ten weeks, with the very low rainfall of 3.94 inches. They should prove a valuable crop in the drier regions and natives like them. Bulking has been commenced at Malakisi.

(2) *Pigeon peas*.—Introduced varieties of pigeon peas are being tried at Bukura, Maseno and Ragunu, but the trials are not yet conclusive. An un-named local variety, obtained from Kikuyu, which is a vigorous grower and a good yielder, has been found to be suitable for most of the dry areas of the Province. This variety is being bulked at Malakisi, Kakamega and Maseno.

(3) *Maize*.—The valuable early-maturing strain, Muratha, is being bulked at and issued from Bukura farm and the seed farms. Varietal trials and breeding work with this and other strains are in progress at Bukura and the seed farms.

(4) *Sorghums*.—The selections of local sorghums, Dobbs and Kano, are the most useful types in the Province and are being bulked on all farms and issues were commenced during

the year. They are very early-maturing and high yielding. Further selection work on the local variety Ik'umba is proceeding at Bukura.

(5) *Eleusine millet*.—The selection Bukura is by far the most early-maturing. *Eleusine* millet, now grown in Nyanza, is being bulked at and issued from Bukura farm and the seed farms.

Increased plantings of all these and the existing famine-proof crops is being encouraged by propaganda.

PLANT DISEASES, PESTS AND WEEDS.

No serious disease or pest outbreaks were reported during the year.

Smut.—The incidence of smut in sorghums has been very low this year.

Rosette Disease of Groundnuts.—This was present as usual with varying severity. Planting is still too widely spaced.

Striga Weed.—The usual campaigns were carried out with the usual partial results. This weed has a very strong hold over much of the Province and its effects, although serious, are so insidious that it is very difficult to persuade natives that it is harmful. Until this is done, partial results only will be obtained because the campaigns, at present, have not the backing of the people.

Bhang.—Growers, when detected, are fined, but much is grown in secret and escapes notice.

Mexican Marigold.—Serious spread of this weed was noticed in Kabras, North Kavirondo, the seed having probably come from the Kipkarren and Nandi farms. Vigorous attempts were made to check its spread and to eradicate it. From its vigorous growth, however, it is obvious that the conditions are very suitable for it.

McDonaldi.—Increasing quantities of this weed are noticed, and welcomed as an aid to soil cover and control.

Stalk Borer.—Damage was negligible.

Locusts.—A swarm entered South Kavirondo from Tanganyika in February, but no damage was reported. Swarms of immature locusts were in the district from June to October and local damage, not severe, took place. They were not reported elsewhere.

Cotton Pests.—Little damage was done, except by Jassids in part of South Kavirondo. Stainers were present but not in large numbers. No boll worm is yet reported. Slight damage was done by Blackarm in South Kavirondo.

Vermin.—The North and Central Kavirondo vermin gangs carried out systematic poisoning, killing many thousands of vermin.

BUKURA FARM AND SEED FARMS.

Bukura Farm.

Area cleared.—Nil.

Area under crop.—82.87 acres.

Area planted with trees.—25 acres (approx.).

Area under permanent grass pasture.—50 acres (approx.)
excluding rotational pasture.

Total plough, end of year.—79.87 acres.

Area of small-holding.—7.68 acres.

Approximate total.—160 acres.

Total area within the Bukura boundaries.—318.71 acres.

General Description.

Main farm crops (excluding trial and demonstration plots, nursery and school gardens):—

Long Rains

<i>Crops.</i>	<i>Acres.</i>
Maize	50
Sorghums	5
Wimbi	2
Green manure	—
Napier fodder ley	10
Cropping experiments	8

Short Rains

<i>Crops.</i>	<i>Acres.</i>
Maize	—
Rose Coco beans	27
Green manure	15
Weed fallow	15
Napier fodder ley	15
Mtama ratoon	$\frac{1}{2}$

Weed Fallow.

The system of field treatment, as detailed in last year's report, has been adhered to throughout, i.e., the outer fields are used for the production of maize and beans, the latter

entirely for issue in the reserve and the former for food within the school and for issue in the reserve, and the inner fields are used for trials, experiments, the bulking of millets, and other crops required in smaller quantities.

Compost.—During the year, four pairs of 30 in. by 40 in. pits were excavated, below and adjacent to the cattle shed. Mixed materials, left in the shed and thoroughly trampled for a week, produced a good sample of compost within three months. The addition of ammonium sulphate, in quantities of approximately 2 lb. to each pit, appeared to have greatly increased bacterial action. Pits so treated, and when filled with suitable materials, attained initial temperatures ranging from 130° F.—145° F. In all cases, however, initial temperatures, instead of subsiding slowly, dropped rapidly after the first ten days, and at the end of sixteen to twenty days, 80° F.—90° F. only were the maxima. At the end of thirty to forty days, the process seemed to come to a standstill; and yet the quality of the final material in crop results is good, though the material both in appearance and on analysis is incompletely decomposed.

Soil Erosion.—It becomes increasingly apparent that the most effective method of preventing erosion on these fields is the wide base ridge terrace. Contour lines of lemon grass or edible canna serve as a very slight check only where conditions such as these are met with, that is, violent storms of short duration on a non-binding soil having a slow water-absorption capacity.

Ten acres of land, of the inner fields, were terraced. All the work was done with a dam-scoop, which seems to be more satisfactory here than the drag. Terraces were put in a chain apart. Hence, it will be understood, that these fields, with practically speaking, all their top soil removed to the terraces, will be of little use for grain crops during the coming year, and it is proposed that they should be planted with sweet potatoes or Napier grass.

Interplanting maize with Black Mauritius beans has proved the most successful in providing a soil cover after the main crop is removed. Sweet potatoes may possibly produce the same result in stronger soils. So far, growth has been rather too slow and a complete cover has not been attained even two months after the main crop was removed. Earlier interplanting of this cover crop, than was done this year, is hardly feasible.

Anti-erosion measures for the school gardens shows so far that sweet potatoes give the best results, and *Coreopsis* sp. next. *Alternanthera* sp. in growth is not sufficiently recumbent to bind the soil on a steep or almost perpendicular bank.

Pasture and Cattle.—With the distribution of rainfall this year pastures have remained in excellent condition. Regular discing and weeding earlier in the year no doubt helped to preserve them in good heart.

It has not been necessary at any time to supplement the grazing with a grain and oil cake ration.

Poultry.—Young chickens were reared in the orchard and in movable pens in the pasture. Two of the breeding pens were dug up, decouched thoroughly, manured, limed and planted with cabbages. When the latter were almost mature, the birds were returned to these pens. It appears to be successful and if regularly done and the pens used in rotation, ground should not become “soured” and “foul”.

Kakamega.

Total arable areas	...	...	40 acres
Total area under trees	...	...	2 acres

A brick office and seed store were erected during the year, and this farm is now the best equipped and developed in the Province. This is partly due to favourable soil and climatic conditions. Rainfall was high during the year, and gales frequent. Three triple lines of windbreaks were planted to try to check the force of the gales which caused much loss in the maize fields. Apart from this damage, long rains crops were excellent, as were also the short rains crops except for ratoon sorghums. Weed growth including couch was heavy.

Cropping results :—

CROP						Area in Acres	Total Yield in Bags of 200 lb.
LONG RAINS—							
Maize	..	..	..	..	..	15	200
Sorghum	..	..	..	..	..	11	64
Wimbi	..	..	..	..	..	10	48
SHORT RAINS—							
Groundnuts	..	..	..	..	..	3	Not yet Harvested
Beans	..	..	..	..	..	3½	17
Sorghum (Seed)	..	..	..	..	..	4	27
Sorghum (Ratoon)	..	..	..	..	..	8	23
Fallow	..	..	..	..	..	15	—
Miscellaneous Trials	..	..	..	..	..	4	—

Maseno.

Total arable area	...	...	40 acres
Total area under trees	...	...	5 acres

Development of this farm is necessarily slow owing to the severely eroded infertile nature of the land. To assist in recovery an intensive scheme of improvement has been carried on covering the three activities of compost making, Napier grass planting and contour ridging. The last has been particularly successful in stopping erosion.

Cropping :—

Maize	...	...	...	18 acres
Sorghum	...	...	...	12 acres
Groundnuts	...	...	...	15 acres

and small areas of Rose Coco and Black Mauritius beans and Mumias rice.

The erection of the necessary buildings has been vigorously carried on, including a cattle shed and yard and buildings on the detention camp which provides some of the labour for the farm.

Kisii.

Total arable area	...	...	29 acres
Total area under trees	...	...	8 acres

The main work of the year has been the saving of the land from erosion and impoverishment by contour ridging, wind-break planting and the putting down of 6 acres of poor land to Napier grass and 6 acres to *Crotalaria* sp.

Cropping results :—

CROP	Area in Acres	Total Yield in Bags
Maize—Muratha	20	116
Potatoes—Kerr's Pink	1	14½
Wimbi—Bukura	½	3
Sorghum, Bean and Wheat Fields Failed.		

Good progress has been made with buildings, including cart shed, covered cattle yard, milk house, poultry house and instructor's house.

Iwinda Plot.

Following a politico-religious fracas in South Wanga location of North Kavirondo in 1934, the site of the disturbance, amounting to five acres, was taken over at the request of the Administration and now forms a bulking and trial plot

and an instructor's centre. Two and a half acres of Bukura wimbi were planted and yielded 11 bags, and an instructor's house and outbuildings were erected.

Malakisi Plot.

The following crops were bulked in small plots and issued locally: Kano sorghum, groundnuts, pigeon peas, tepary beans, the last being particularly successful in dry weather.

Kendu Plot.

Maize and sorghum were bulked and miscellaneous variety trials were carried out.

CROP	North Kavirondo	Central Karivondo	South Kavirondo	Total
FROM DEPARTMENTAL FUNDS AND BUKURA FARM	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>	<i>Bags</i>
Maize	164*	—	—	164
Eleusine	10*	—	—	10
Sorghum	6*	—	—	6
Groundnuts	73	49	64	186
Potatoes	—	—	16	16
*Ex Bukura				
FROM LOCAL NATIVE COUNCIL FUNDS				
Groundnuts	32	173	—	205
Potatoes	10	—	—	10
Rice	21	—	4	25
Black Wattle.. ..	4	4	4	12
FROM LOCAL NATIVE COUNCIL SEED FARMS				
Maize	248	60	42	350
Eleusine	34	—	—	34
Sorghum	47	10	—	57
Groundnuts	8	54	—	62
Potatoes	30	—	2	32
TREE SEEDLINGS ISSUED FROM NUR- SERIES (Approx.)..	168,000	811,000	118,000	1,097,000

In addition to the above, large quantities of vegetable seeds in packets were issued either free or for sale, together with small quantities of miscellaneous tree seeds.

IMPROVEMENT OF QUALITY OF PRODUCE.

Successful results have attended the introduction of compulsory central produce inspection in Nyanza Province. A start was made with central inspection of groundnuts in South Kavirondo in 1933, the system being extended to the North and Central Kavirondo districts during 1935.

The system is now employed at all the principal trading centres in South Kavirondo, but in North and Central Kavirondo, central inspection has, so far, only been adopted in the Kisumu-Butere branch line trading centres, Yala, Luanda and Lela. Extension is to take place in 1936. Native producers have quickly adopted the new procedure of selling with inspection tickets and using clean baskets. The system has the general support of traders, who in some cases have provided the funds necessary for the employment of inspectors.

Already the system has caused a marked improvement in the quality of produce. Natives are now more careful to submit uniform parcels for inspection and this has acted as a means of compulsory selection of sound seed, which in itself is increasing yields. Inspection for quality, cleanliness and pureness of variety of beans in South Kavirondo has resulted in a substantial increase in the price offered for Canadian Wonder over mixed beans. The greatest improvement is in the groundnut crop, inspected in South Kavirondo since 1933. The demand has increased and the nuts can compete with those grown elsewhere. Improvement of simsim had previously been obtained by the use of winnowers at all trading centres in the Province, but further improvement has resulted from central inspection. Choroko (gram) has also been improved in quality and purity of sample. Central inspection has resulted in the elimination of dunged baskets for the transport of produce.

INCREASED PRODUCTION.

Cotton.—The rapid increase in production is still maintained, the increase in the 1934-35 crop over that of the previous year being 44.6 per cent.

Groundnuts.—The crop was restored to its original importance in South Kavirondo which exported 522 tons. Elsewhere development is slow.

Simsim.—Production increased.

Maize.—Production increased, partly due to internal demand.

Rice.—This crop, which is still in its early stages, was considerably developed.

Tobacco.—The small industry at Butere showed a good increase.

Black Wattle.—This crop is not productive yet; increased plantings took place.

Food Crops.—There were plentiful supplies of food crops throughout the Province. Vegetable and famine crops increased.

Approximate quantities (in tons) of certain produce put on rail at certain groups of stations or ports.

	Gulf Ports	Butere Line	Uganda Line
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
Maize	1,090	11,440	23,620
Maize Meal	—	400	200
Simsim	1,215	320	380
Eleusine	940	4	20
Groundnuts	590	100	—

In addition to the above figures, which are given for interest only and not as a record of production, large quantities of produce are sent to Kisumu mills by road and large quantities also are consumed internally. It would not be possible, without very considerable expenditure of time and labour, to produce complete figures of production, as, apart from cotton, all crops are subject to consumption to a greater or less extent by the growers, and, apart from that, much produce that the growers sell never leaves the Province.

IMPLEMENTS.

The increasing interest in cash crops and the increased financial resources derived from them have been reflected in increased sales of implements, particularly ploughs. It is estimated that about 3,000 ploughs are now in use in the Province. A leading firm in Kisumu, importers of Ransomes implements, reported the following sales during the year:—

Ploughs, 862; plough shares, 212; trek chains, 276; harrow sections, 7; mills, 29; separators, 30.

There are, besides, other firms handling other makes of ploughs, including many non-British makes, and almost every trading centre is always to be seen with up to a dozen ploughs on show for sale. The interest in ploughs has received much encouragement from the large reduction in price. The most popular, the Victory (Ransomes), is now about Sh. 40 and the E.C.A. about Sh. 60, compared with approximately Sh. 60 and Sh. 100 respectively last year.

Progress is recorded in the adoption of donkeys for pack transport and also in the number of native-owned ox-carts.

SOIL FERTILITY AND EROSION.

The need for maintaining soil fertility and the prevention of soil erosion was continually in the forefront of all propaganda, special demonstrations being given in many of the worst eroded areas, particularly on the hill sides, where loose stones are available for building contour bunds and on the hot dry plains where aloes have been found successful. A special campaign was conducted in the South Maragoli location of North Kavirondo, and, to continue this work, the Local Native Council has voted £350 for work in 1936.

Local rules regarding the control of grass fires have been in operation but they are, at times, none too easy to enforce.

The use of manure pits and compost making has also been extended, and, in general, it may be said that where any methods of soil control have been demonstrated and proved, they are being slowly adopted.

MIXED FARMING AND SMALLHOLDINGS.

The importance of the adaptation or moulding of native methods of land management into sound systems of mixed farming has not been overlooked. It is necessary not only to produce a more economical use of the land and greater returns per acre, but also as a measure to check the serious loss of fertility that is happening in many parts. In the more closely populated areas, mixed farming will enable the increasing population to make fuller use of their land, but it is precisely in these areas that difficulties of land tenure militate so strongly against the development which depends to such a large extent on secure individual ownership or cultivation rights over blocks of land. Until these land tenure problems are tackled and some of the problems solved, progress in this direction must be slow.

Reference is made to the demonstration smallholding at Bukura in a separate report on smallholdings which appears elsewhere in this volume.

NATIVE AGRICULTURAL TRAINING.

This is reported on by the Deputy Director. A full report is available from the Agricultural Officer, Bukura.

INVESTIGATIONAL WORK.

This is reported on by the Deputy Director.

W. O. SUNMAN,
Agricultural Officer,
Acting in Charge of Nyanza Province.

REPORT OF THE COAST PROVINCE

EUROPEAN STAFF.

This consisted of one Provincial officer (also in charge of Kibarani Experimental Station), two district officers and one Asiatic assistant for the Tana River area.

NATIVE STAFF.

Native Agricultural Instructors at the end of the year were stationed as follows :—

DISTRICT					Depart- ment of Agriculture	Local Native Council	Total
Kilifi	..	..	..	..	8	7	15
Malindi	..	..	..	..	9	—	9
Digo	..	..	..	..	10	3	13
Mombasa	..	..	..	..	1	—	1
Lamu	..	..	..	..	1	—	1
Tana River	..	..	..	..	2	—	2
Teita	..	..	..	..	1	4	5
Garissa (N.F.D.)	..	..	..	..	1	1	2
Kibarani	..	..	..	..	4	—	4

Seven apprentices remained in training at Kibarani at the end of the year.

SEASONAL CONDITIONS.

Taking the year as whole, it was undoubtedly much better than the two previous ones. As will be noted under their respective heads one or two crops suffered from strikingly unsuitable conditions at critical stages but the majority did well.

The long rains were remarkable for the unusual length of their duration. A dry period occurred in June but afterwards light rains continued until October. There was then a dry period but in December short rains began in the back country, reaching the Coast strip towards the end of the year and continuing into the New Year.

The year, therefore, proved one of high rainfall, but extremes of drought and excessive wetness were less than in most years.

CROPS.

Maize.—The year opened with food on the short side and a good long-rain crop was needed. This was obtained everywhere with the exception of Vitengeni, in Kilifi district, and

parts of the Malindi Reserve, where the crop suffered from drought at a critical period. Food was plentiful in the second half of the year in consequence.

Short-rain crops were not too promising in Digo but should prove very satisfactory in the Nyika Reserve of Kilifi and Malindi.

Rice.—The rice area of Kau and Ozi on the Tana River gave good crops and the position of Tana River rice in the Lamu market has improved greatly recently, the variety now mainly grown in the Kau area commanding the highest price in Lamu.

At Vanga good results were also obtained though the rain-grown crop failed in other parts of Digo.

Other cereals still play but a small part in Coast agriculture. Good yields of bean crops were obtained.

Coco-nuts.—These improved and should be still better next year as they recover from locust ravages. Prices were higher towards the end of the year and a good market for whole nuts was available in Mombasa.

Sugar.—In the neighbourhood of Ramisi, sugar is becoming increasingly popular with the natives, who are able to sell to the local factory at good prices.

Cotton Season, 1935-36.—The further extension of cotton-growing continued to be the main work of the year and is considered more fully in a later paragraph. The season proved to be a good one with improvements in quality as well as in quantity. The buying figures were as under :—

	lb.
Malindi Sub-District	2,575,423
Kilifi (excluding Malindi) ...	1,191,028
Digo District	635,739
Lamu and Kipini Districts ...	259,546
Mombasa District	96,561
Teita District (Taveta)	66,058
	4,824,355

Of the total quantity bought, 3,528,256 lb. were of "A" quality, and 1,291,099 lb. were of "B" quality.

The total figure for seed cotton is equivalent to 3,617 bales of ginned cotton. This shows an increase of 130 per cent in the last season over the previous one. The increase over the season 1933-34, when the production reached 1,059 bales, is 240 per cent.

The end of the season promised to be complicated by heavy short rains arriving late in the season.

Simsim.—The early simsim crop was poor owing to wet weather, but late plantings gave good crops and where short-rain plantings have been done good crops should be obtained.

Cashew Nuts.—Further improvements in the factory side of this industry were made during the year and the opening of the 1935-36 buying season saw all arrears of nuts disposed of. Improvement in the quality of the finished product should result from quicker handling. The crop promised to be a good one but continuance of rain into the New Year was impeding its harvesting.

PESTS AND DISEASES.

Jassid was more noticeable in the cotton shambas than it has been in the past and appears to justify the policy of carrying out trails with jassid-resistant types.

Stainers were less serious than in the previous year, but the proportion of stained cotton in the new areas is still considerably higher than it is in the old Malindi-Mambrui areas. It is likely that this is due to some extent to the fact that in the new areas planting hitherto has been generally later than in the older ones.

In a limited part of Digo district, near Mombasa, mealy bug has damaged cotton. Leaf-rolling caterpillar has been present but to a less extent than in the previous season; it can be easily controlled by hand-picking if early action is taken.

Pink boll-worm was present but continues not to be a serious pest under Coast conditions.

LOCAL NATIVE COUNCIL SEED FARMS.

Owing to bad seasons and famine relief, the Local Native Councils of Kilifi and Digo found themselves in a weak financial position and it became necessary to reduce the amounts available for agricultural services.

As in the previous year a part of the Station at Kibarani was used again for bulking crops for both districts, though the acreage was reduced.

The seed farm at Kwale continued satisfactorily and with the appointment of an Assistant Agricultural Officer to Digo district, it will be possible to develop that more fully for the benefit of Digo, leaving Kibarani to serve Kilifi and those districts without Local Native Councils.

One of the main functions of seed farms on the Coast must be the bulking of proved drought-resistant crops and the demonstration of their value.

SEED FARM	Area Cleared	Area under Crop	Area under Cover Crops
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Kwale	30	15	5
Kibarani (Bulking Area only)	100	50	20

At Kwale a fumigating chamber was completed and it is now possible to hold seed over from long rains to long rains. Some 65 bags of Yellow Menado maize are now in hand ready for issue in 1936.

SEED ISSUES FROM LOCAL NATIVE COUNCIL FUNDS

CROP	Digo District	Kilifi District
	<i>Bags</i>	<i>Bags</i>
FROM KIBARANI EXPERIMENT STATION—		
Maize	30	46
Sorghum	10	—
Foxtail Millet	8	12
Bulrush Millet	8	1
Cowpeas	10	4
Tepary Beans	25	14
FROM KWALE SEED FARM—		
Tepary Beans	20	—
PURCHASED—		
Tepary Beans	10	—

DEVELOPMENT WORK.

Cotton.—The general backwardness of Coast tribes continues to make it necessary not to attempt to cover too wide a range of work but to concentrate on certain lines until they are within reasonable range of becoming established. Consequently, the main feature of extension work has continued to be the development of the cotton crop; for until a staple cash crop forms a natural part of the native's economy, progress is bound to be slow and liable to frequent setbacks.

The establishment of such a crop is of fundamental importance, not only by the immediate cash benefits, but also because it should form the foundation on which to base further development and improvement. In the past it has been extremely difficult to find such a foundation. The type of marketing possible in other areas has been too advanced for these; even the native markets usual elsewhere are strikingly absent in most parts. Cattle are limited to certain areas and even these are by no means free from tsetse. A tribe such as the Giriama have no interest in money. Given plenty of food at a given moment, they have no other wishes and are lukewarm even towards measures aimed at the prevention of famine. Add to this the low density of population and poor communications and it is possible to visualize the nature of the problem to be solved.

That there has been a satisfactory advance in the cotton crop, therefore, needs special note and it is not out of place to note briefly the objects of the season's work and the degree in which success was achieved.

(i) In Digo district a great effort was made to follow up the introduction of cotton which took place in the previous years. The acreage under cotton increased from 800 to over 3,000. The total yield, however, promised to fall short of the estimate owing to very dry conditions in the latter part of the year. In all new areas there is a tendency to plant late, which may lead to some reduction in the crop, and this probably accounts for the increase being less than expected. In this district also much of the land is of poor fertility and in such areas yields per acre are certainly less than in the northern areas.

(ii) In the Nyika Reserve of Kilifi and Malindi an effort was made to recover ground lost by bad seasons and to try to establish the crop satisfactorily. In 1934-35 the crop in this area had fallen to about 150,000 lb. In the season under review, it is expected that over 800,000 lb. will be obtained. More important in some ways is the probability that the crop has now been largely accepted as a valuable part of their economy by the Malindi and northern Kilifi locations.

(iii) Very small issues of seed had been made a year earlier in Lamu and Tana River districts and a serious effort to develop the crop was made. The total crop from the two areas was expected to be little short of a quarter of a million pounds of seed cotton and the position was so encouraging

that a proposal to establish a small ginnery at Lamu to serve the two districts was under consideration at the end of the year.

(iv) In addition to the above main points, propaganda was continued in the Kilifi-Malindi coastal area and very satisfactory increases were recorded generally.

(v) As already noted, no Agricultural Officer has yet been stationed in the Teita area. In the Taveta area of that district, however, the Tanganyika Department has very kindly given assistance to the District Commissioner in the developing of cotton-growing. The population affected is not large and the result obtained is very satisfactory.

It will be seen, therefore, that the progress made is not confined to any one area. It is general and does promise to provide that basis so urgently needed.

The cashew nut industry has continued to be fostered by encouraging planting and the tree as a permanent crop is becoming increasingly popular in areas around Kilifi. It has other uses besides being a cash crop, as it can help as a famine reserve and is of great value as a windbreak with all that that implies under Coast conditions.

Bees-wax.—The possibility of fostering the production of bees-wax came under review at the end of 1934. As is not unusual on the Coast, it proved to be a case of starting at the beginning instead of improving an already existing industry. Inquiries showed that the WaSanye collected wild honey and in parts of the Nyika Reserve a few hives were kept, though the only place where any number seemed to be in existence was amongst those Akamba settled in the Mariakani area. Elsewhere the keeping of bees is almost non-existent. Bees-wax was thrown away mainly, only a negligible amount and that of very poor quality finding its way into Mombasa. Further inquiries showed that an earlier attempt to foster the industry had failed, both natives and duka owners finding no profit in it.

In these circumstances it was clear that nothing could be done without organizing the marketing side first. Accordingly, the good offices of a Mombasa firm were requested and by arrangement with them a number of dukas in Kilifi and Malindi arranged to buy clean wax at an agreed price. The same firm also provided material for the construction of petrol-box hives, which were made during the year and issued to selected natives for observational purposes.

Natives were then taught how to prepare clean bees-wax and told where to sell it to get the proper price. A start has consequently been made in what should prove to be a useful industry, especially in the poorer back areas. Although no great quantity of wax is yet available, the quality is satisfactory and the scope of the industry can be extended as this first area becomes established.

Famine Prevention.—The work at Kibarani has now provided a selection of drought-resistant crops, which are definitely suitable for the Coast and it is essential that the native should be taught their value and the place they should take in his shamba. In the Duruma country of Digo district, issues of Yellow Menado maize and tepary beans have been continued and these crops are welcomed by the natives. Pending the work on maize varieties, however, more attention has been paid in Kilifi district to the issue of mtama and fofaxtail millet as well as teparies. The serious food shortages of recent years have made it difficult to introduce properly the agreed system by which selected locations can be used to hasten the speed of bulking and this work has consequently been carried out under considerable difficulties. With the end of 1935 seeing the reserves well supplied with food, the position is more readily attacked.

Restoration of Soil Fertility.—In Digo district there is much land, which was naturally probably of only moderate fertility, that has become extremely poor by constant cultivation and heavy planting of cassava. No remedial measures were practised and restoration by shifting cultivation was limited owing to the short resting period possible. These areas, however, do contain a number of cattle, the manure from which was not used. Further, the absence of wild animals has made it a usual custom just to tether cattle at night instead of shutting them up in a boma. In the year under review encouragement has been given to the use of manure on the shambas and the tethering of the cattle on and coming under cultivation next season. A joint scheme of village clearance and composting of wastes has been discussed with the District Commissioner and the medical officer and suitable rules have been passed by the Local Native Council ready for inaugurating work on these lines in the New Year.

On these light soils a very small dressing of manure has a striking effect and the advancement of this work should be of great benefit to the areas affected.

EDUCATION.

Although no proper facilities are yet available at Kibarani for establishing an agricultural school, apprentices have been taken on and are being given what is essentially a practical course in field work. They have had little education and drastic selection is necessary, which makes progress slow. In the absence of better facilities, however, this training does turn out a more useful individual than the average instructor of the past.

During the year proposals were put up for the establishment of a small Agricultural Training Centre at Kibarani, which would ultimately comprise thirty pupils, and would be capable of turning out ten per annum after the first three years. The implementing of these proposals would be of the greatest benefit.

COMMUNICATIONS.

It cannot be said that communications have improved during the year. The lowering of ferry tolls at Kilifi and Mtwapa was almost immediately more than offset to the producer by an increase in lorry tolls on the Nyali bridge.

Traffic along the coast roads continues to expand and is increased by the growing of the cotton industry. The burden of the tolls, far from diminishing, is steadily increasing, and is definitely a handicap on development.

Roads improved from the state to which they had been reduced by the wet year of 1934 but once the main coast roads are left, communications are still very poor as some roads continue to be in very bad condition. It should scarcely be necessary to point out that improved communications must accompany increased production, if the latter is not to slow down. Good roads are obviously an integral part of a development programme.

COAST ADVISORY COMMITTEE.

The Committee held four meetings during the year and discussed a wide variety of subjects. The last meeting was called to meet Sir Alan Pim and Mr. Milligan, when members' views of coast needs were placed before the Commissioner.

The Committee is serving an increasingly useful purpose, as many of the subjects are of peculiar concern to the coast, where conditions are so extremely different from other parts of the country.

FIELD WORK IN 1936.

Although much remains to be done to consolidate and extend the cotton crop, it is hoped that in large parts of the coast the crop is now accepted. This means an increase in our influence in those areas and enables the scope of extension work to be broadened with greater prospects of success than would have been the case in the past. Further, Kibarani is giving us a sound foundation, on which to work out proposals for development. Thus in the coming year the following items are some of the main ones to which attention will be devoted :

1. Continued bulking of drought-resistant crops and their organized introduction into cultivation.

2. Soil conservation and measures against erosion.

(a) Use of manure and compost making from village cleaning scheme.

(b) Demonstrations of ridging methods.

(c) Cashew nuts; planting for windbreaks and re-afforestation as well as for crop.

(d) Introduction of simple contour measures against erosion.

(e) In Teita District wattle planting and other anti-erosion measures.

3. Development of bee-keeping and marketing of bee-products.

COAST EXPERIMENT STATION, KIBARANI.

During the year the following buildings were erected :—

(a) Three-roomed office.

(b) A 20,000-gallon water tank for the nursery.

(c) A threshing floor.

(d) Two temporary stores built with ant-resisting timber.

In the previous year a large seed-store had been completed and a small temporary tobacco curing barn.

The labour lines continue to be of a temporary nature. Such buildings are neither good nor economical and a plan for a permanent camp was submitted for consideration in connection with the proposal to establish a training centre.

With no departmental money available for capital expenditure, field development has necessarily been slow. The object in view has been to bring the cleared land into good

farming conditions and to proceed steadily with the process of laying out the different fields, making roads and planting wildbreaks. To this end some 35 acres of land were cleared of stumps, estate roads were constructed and lined with avenues of cashew-nut trees. Some ridging was carried out as the first stage of a general scheme, whilst in the short rains some 20 acres of the older land was put down to a cover-crop for a period of rest.

In the continued absence of money for development purposes, the same process will need to be continued if the Station is to be developed.

INVESTIGATIONAL WORK IN 1935.

A report on this will be found in the Deputy Director's report.

GENERAL.

An exhibit was staged at the Mombasa Trade Exhibition in January, when produce from all the districts as well as material from Kibarani was shown.

During the year special reports were submitted on development problems in Teita, Tana River and Lamu districts. Their object was to point out lines along which development can proceed as soon as the necessary staff becomes available.

The Local Native Councils continue to devote a proportion of their funds to agricultural purposes. In Teita, indeed, they have to do most of what is being done there. In Kilifi and Digo, though the Councils are still largely inarticulate, they appear to be taking an increasing interest in agricultural affairs, which is undoubtedly all to the good.

In conclusion thanks and appreciation are due to all Administrative Officers, who have extended the fullest co-operation and help to officers of this Department.

N. HUMPHREY,

*Provincial Agricultural Officer,
Coast Province.*

Part VI.—Agricultural Training, Smallholdings

Smallholdings have been established by the Agricultural Department at the Scott Agricultural Laboratories and the Native Agricultural School, Bukura, and by the Education Department at the Jeanes School, Kabete, for the purpose of investigation and of giving instruction in mixed farming methods to the agricultural apprentices, Jeanes teachers and others in training at these centres.

At the Scott Agricultural Laboratories and Bukura, the holding is occupied for periods of one year or more by a selected apprentice, who is responsible, under the supervision of the Agricultural Officer in charge, for the complete running of the holding. In all three cases the occupant ranks as a tenant, the rights and duties of the landlord being vested in the school. The system is a form of share tenancy.

This system is adopted for convenience of operation and does not affect the object for which these holdings have been established. That object is to teach natives, by ocular demonstration and actual personal experience, a system of mixed farming, designed to meet the complete requirements of a native family of average size. The acreage of these holdings is not greater than a family could obtain under the present conditions of land tenure in the native reserves. The mixed farming systems employed on these holdings are similar; minor differences being introduced to fit them for the localities in which they are situated, that is, Nyanza and Central Provinces, but in each case the system is designed to maintain and improve soil fertility, besides giving a living to the occupant.

The accounts shows that a family can derive a living from such holdings, with surplus cash for non-essential domestic and personal expenditure.

SMALLHOLDINGS AT JEANES SCHOOL, KABETE.

The arable acreage is approximately $5\frac{1}{2}$ acres, with some 20 acres of pasture and enough wattle to supply firewood. The farm buildings, as distinct from the dwelling house, are of the cheapest possible wattle-daub construction.

The basic idea of the holding is to allow the tenant to farm more or less in his own way, within the limits of a cropping scheme previously laid down. In the rotation followed, it is endeavoured to combine the best of both African

and European methods, judged purely from the economic point of view; that is, if the African method is more economical, the European method is not sought to be imposed. For example, the native practice of attempting to obtain two crops of maize in one year, which is definitely impracticable in most years, has been rejected, while their practice of interplanting maize, in the long rains, with a two-season crop, such as sweet potatoes or pigeon pea, has been retained.

Interplanting of maize with sweet potatoes is considered to indicate a solution of many of the problems of mixed farming on small holdings. More human food is produced than by other systems, the soil is protected from sun and rain, there is constant insurance against locusts and the sweet-potato tops and roots provide a large amount of fodder for the working cattle, provision for whose maintenance is otherwise difficult on a smallholding. The deep rooting habit of the pigeon pea is also valuable.

One-third of the total arable acreage is planted each season with maize and the subsidiary crop. One-third is still under the previous season's subsidiary and the final third is divided between annual crops, usually English potatoes and beans. Onions, wheat and field peas have also been tried in this part of the rotation. There are also small plantings of yams and cassava.

The tenant benefits by the proximity of a large market. The students in training also take a good deal of produce. Better financial results might have been obtained by specializing in vegetables and poultry. This, however, is discouraged as it is the aim to show how to cultivate the more ordinary crops.

The tools and implements in use, with valuations, are as follows :—

	<i>Sh.</i>
Plough with Yokes and Chains	60
Cultivator, Rigid	50
Harrow, Single Section	45
Planet Junior Hoe	35
Wheelbarrow	35
Hand Tools (including Saw)	25
Total without Cart	250
Ox Cart, Small	150
<i>Sh.</i>	400

The average complement of live stock during the two-year period under review was four trained work oxen and two cows. Hand-rearing of calves was not attempted. Over the whole period, the two cows gave 4,230 pints, an average of 180 pints per month, or 3 pints per day per cow, but there were periods when both cows were dry together. A continuous supply could, however, be arranged.

Income and expenditure are detailed and analysed in the following figures :—

RECEIPTS FOR SALE OF PRODUCE

RECEIPTS						1st Year		2nd Year	
						<i>Sh.</i>	<i>cts.</i>	<i>Sh.</i>	<i>cts.</i>
Maize	..	..	..	..	..	34	90	96	25
Potatoes	..	..	..	..	..	169	80	50	65
Beans	..	..	..	..	..	14	70	25	85
Milk	..	..	..	..	..	34	40	7	60
Eggs	..	..	..	..	..	28	14	21	01
Onions	..	..	..	..	..	23	26	1	05
Vegetables	..	..	..	..	..	8	99	7	35
Sweet Potatoes	..	..	..	..	..	21	95	64	95
Poultry	..	..	..	..	..	—		11	60
TOTAL RECEIPTS ..						<i>Sh.</i>	336 14	286	31
EXPENDITURE									
Food	..	..	..	..	..	40	24	38	21
Oil and Soap	..	..	..	..	..	13	39	16	41
House	..	..	..	..	..	23	20	24	06
Clothes	..	..	..	..	..	43	10	47	14
Farm	..	..	..	..	..	35	60	18	05
Wages	..	..	..	..	..		60	5	20
Rent	..	..	..	..	..	84	15	47	34
Miscellaneous	..	..	..	..	..	7	78	17	10
TOTAL EXPENDITURE ..						<i>Sh.</i>	248 06	213	51
Total Receipts in two years ..						..	..	622	45
Total Expenditure in two years ..						..	..	461	57
SURPLUS CASH IN HAND ..						..	..	<i>Sh.</i>	160 88

Over this two-year period the family have been completely fed and clothed and its miscellaneous wants have been met from the holding.

SMALLHOLDING AT BUKURA, NORTH KAVIRONDO.

At Bukura, the design of the teaching is to comprise a group system of holdings, with enclosed communal grazing. A group of native farmers, working their land on a mixed

farming system and having holdings near to each other, are visualized as using a communal tract of pasture for their stock and eventually adopting a co-operative system of buying and selling farm products, implements and seeds. The reason for postulating enclosed, controlled communal grazing is that the average native landholder has not individually enough land to feed a sufficient number of cattle for work and milk-production on a 6 to 8 acre holding, unless he overstocks his land and defeats one object of the mixed farming system, namely the conservation and maintenance of the soil and its fertility.

The Bukura holding covers 7.68 acres of land and is intended to maintain one native family of average size and to produce a cash profit over and above that.

The holding comprises five fields, which are cropped on a definite rotation, some small permanent or semi-permanent plantations, a house and farm buildings. It is designed to be run on such lines that the land will be improved from year to year. The fields are cropped firstly to give an adequate food supply for the family and secondly to give a surplus of produce which is sold for cash.

The homestead and farmyard are designed as a demonstration of hygienic village methods for natives, showing them how men and cattle can live near to each other, each in their respective houses, without filth and disease.

The cropping is based on a four-course rotation, giving two crops per year, with periodic reversion to pasture. There is one leguminous green manure and one sweet-potato crop, interplanted in maize, which serves in part as a green manure. Compost is regularly applied, the aim being to manure at least one whole field a year in this way.

The field under pasture serves as a night paddock for work oxen.

The rotation is :—

		Long Rains	Short Rains
1st Year	..	Maize.	Sweet Potatoes.
2nd Year	..	Eleusine and Foxtail Millets.	Onions.
3rd Year	..	Sorghum (Onions).	Green Manures.
4th Year	..	Maize.	Pulses.
5th Year	..	Pasture.	Pasture.
6th Year	..	Pasture.	Pasture.
7th Year	..	Pasture.	Pasture.

The sweet potatoes are interplanted in the maize before it is harvested. Eleusine and foxtail millets have been planted in alternate rows in the same fields. The most paying cash crop is at the present time onions, grown in the short rains.

The cropping can be modified according to the local market requirements, but does not lend itself to the development of the stock side of the holding. If it were desired to introduce intensive milk production, the cropping system would have to be modified. As it stands, the holding is mainly dependent on the sale of cash crops for income, the most paying of which are maize, onions and eleusine millet. Eggs also are profitable.

At present, the stock comprises two native cows, three calves and six oxen. The cows and calves are housed in the cow shed, having two compartments, from which material (bedding) is obtained for composting. The oxen are paddocked at night in the grass field, the two paddocks of which are grazed alternately. During the day time, all stock goes out to the communal grazing ground. The poultry are purebred Rhode Island Reds, with some native hens for sitting. Egg-production is chiefly aimed at. In addition to onions and pulses, which are treated as field crops, vegetables and fruits are grown near the house for the family's needs. Surplus produce is sold. A plot of Napier grass provides bedding for the cowshed, material for the compost pits and extra fodder for the stock. Hives are being started and it is intended to produce honey and bees-wax on the holding.

Two financial years, 1st June to 31st May, have closed since the occupier entered into possession. The system of accounting followed is based on an adaptation for natives of a single entry system. It has been found to work satisfactorily since it was first tried last year.

RECEIPTS AND EXPENDITURE

1ST JUNE, 1933 TO 31ST MAY, 1934

RECEIPTS		EXPENDITURE	
	<i>Sh. cts.</i>		<i>Sh. cts.</i>
Total Animal Produce :		Total Farm Costs ..	208 86
Eggs	17 84	Cash in Hand, 31-5-34	144 56
Total Crop Produce :			
Maize	184 00		
Sorghum	14 74		
Eleusine Millet ..	48 25		
Vegetables	42 66		
English Potatoes ..	45 93		
TOTAL ..£	353 42	TOTAL ..£	353 42

RECEIPTS AND EXPENDITURE

1ST JUNE, 1934 TO 31ST MAY, 1935

RECEIPTS		EXPENDITURE	
	<i>Sh. cts.</i>		<i>Sh. cts.</i>
Total Animal Produce :		Farm Costs	166 35
Eggs	23 66	Cash Paid into Bank..	185 00
Poultry	20 00	Cash in Hand at 31-5-35	4 14
Total Crop Produce :			
Maize.. .. .	46 23		
Eleusine Millet ..	21 00		
Onions	79 60		
Vegetables	13 47		
Fruits	2 96		
English Potatoes ..	4 00		
Other Receipts ..	144 57		
TOTAL ..	355 49	TOTAL ..	355 49

CAPITAL ACCOUNT

VALUATION—1ST JUNE, 1933

	<i>Sh. cts.</i>	<i>Sh. cts.</i>
BUILDINGS—		
Dwelling House	210 00	
Crib	83 00	
Cattle Shed	88 00	
Poultry Run	94 00	
Implement Shed	81 00	
Paddock	51 00	
Nursery Wire	2 00	
		609 00
IMPLEMENTS—		
Ox Cultivator	25 00	
Hand Cultivator	15 00	
Plough	30 00	
Tine Harrow	25 00	
Wheelbarrow	12 00	
Two Jembies	2 00	
Two Pangas	2 00	
		111 00
LIVE STOCK—		
Two Cows at Sh. 120	240 00	
Poultry	8 50	
Ducks	6 00	
		254 50
PRODUCE, FEEDING STUFFS, ETC. IN HAND		..
Total Stock	974 50	
Cash in Hand	—	
Cash at Bank	—	
TOTAL	974 50	

CAPITAL ACCOUNT
VALUATION—1ST JUNE, 1935

					<i>Sh. cts</i>	<i>Sh. cts.</i>
BUILDINGS—						
Dwelling House	..	..	..	..	193 20	
Crib	..	..	..	..	62 20	
Cattle Shed	..	..	..	..	53 60	
Poultry Run	..	..	..	..	75 20	
Implement Shed	..	..	..	..	64 80	
Paddock	..	..	..	..	40 80	
Nursery Wire	..	..	..	..	1 60	
						491 40
IMPLEMENTS—						
Ox Cultivator	..	..	..	..	20 00	
Hand Cultivator	..	..	..	..	12 00	
Plough	..	..	..	..	22 00	
Tine Harrow	..	..	..	..	21 68	
Wheelbarrow	..	..	..	..	6 00	
Two Jembies	..	..	..	..	68	
Two Pangas	..	..	..	..	68	
						83 04
LIVE STOCK—						
Two Cows at Sh. 200 and Sh. 60	..	..	..	..	260 00	
One Bull Calf, 23 months	..	..	..	..	18 00	
One Bull Calf, 14 months	..	..	..	..	14 00	
One Heifer Calf, 10 months	..	..	..	..	16 00	
Poultry :						
Twenty R.I.R. Hens	..	..	..	..	60 00	
Two R.I.R. Cockerels	..	..	..	..	8 00	
Ten Native Hens	..	..	..	..	5 00	
						381 00
PRODUCE, FEEDING STUFFS, ETC. IN HAND—						
Eleusine Millet, Eight Bags at Sh. 7..	..	..	..	..	56 00	
Maize, Fifteen Bags at Sh. 3/50	..	..	..	..	52 50	
Maize, Three Bags at Sh. 5	..	..	..	..	15 00	
						123 50
Total Stock					..	1,078 94
Cash in Hand					..	3 34
Cash at Bank					..	185 00
TOTAL .. Sh.						1,267 28
Balance—1934-5						45 50

SMALLHOLDING AT THE SCOTT AGRICULTURAL LABORATORIES,
KABETE.

The smallholding at the Scott Agricultural Laboratories is run on similar lines to the holding at Bukura, but the system of cropping is one which is designed for the local conditions and includes the crops commonly grown by natives in the Central Province.

The value of this holding is more for the education of native agricultural apprentices in methods of mixed farming than for proving the actual financial value of the holding.

The annual statement of account for the year ending 31st December, 1935, is as under :—

	<i>Sh. cts.</i>		<i>Sh. cts.</i>
Valuation, 1-1-35 ..	1,174 00	Receipts as per C.B.—	
Payments as per C.B.—		Crops	234 00
Wages	120 00	Milk	534 00
Feeding Stuffs ..	586 72	Ghee	11 25
Live Stock	5 00	Eggs	144 18
Seed	50 00	Pigs	505 75
Balance—Profit ..	592 46	Poultry	17 00
		Valuation, 31-12-35..	1,082 00
	<i>Sh.</i> 2,528 18		<i>Sh.</i> 2,528 18

In this statement no account has been taken of the food consumed by the smallholder. The item “Wages” represents the wages paid by the occupier for labour employed by him during the course of the year on the holding.

The receipts from the sale of certain items, notably pigs and milk, are comparatively high on account of the proximity of the holding to Nairobi. Most produce is sold in the Nairobi market, the prices obtained being higher than those which similar produce would fetch in the native reserves. When allowance is made for this, a substantial profit on the year’s working would still be shown, however.

Thanks are tendered to the hon. the Director of Education for permission to include in this report a description of the smallholding at the Jeanes School, Kabete, and to Mr. T. G. Benson, Principal of the Jeanes School, and to Mr. Walford, of the Education Department, for placing at the disposal of this Department a report on the Jeanes School smallholding. Information has been drawn freely from that report in compiling the section which deals with the smallholding at the Jeanes School.

ANIMAL INDUSTRY

Part VII.—Report of the Chief Veterinary Research Officer

STAFF.

The Chief Veterinary Research Officer returned from vacation leave on the 12th January, 1935.

Mr. J. R. Hudson reverted to his substantive rank of Veterinary Research Officer and was on duty throughout the year.

The post of Assistant Chief Veterinary Research Officer remained unfilled throughout the year.

Mr. W. B. C. Danks and Mr. W. Fotheringham, Veterinary Research Officers, and Dr. E. A. Lewis, Entomologist, were all on duty throughout the year.

Dr. J. Anderson, Veterinary Research Officer, returned from vacation leave on the 1st June, 1935, and proceeded to the Naivasha Experimental Station to begin the investigational work in connection with nutrition and animal breeding. A new laboratory has been built and equipped. The building is of stone and comprises a laboratory, office, store, incubator room and small animal accommodation. This new research station is financed by a grant from the Colonial Development Fund which is to be spread over a period of five years.

Mr. J. A. Blundell was appointed to the post of Farm Manager of the Government Experimental Station with effect from the 1st October, 1935.

Mr. D. C. Edwards, Agricultural Officer in Charge of Grassland Improvement, was on duty throughout the year.

Mr. A. J. Kemp, Laboratory Superintendent, proceeded on vacation leave on the 23rd January and returned to duty on the 2nd September, 1935.

Mr. F. Lyons proceeded on vacation leave on the 11th November, 1935.

Messrs. J. T. Schultz, H. J. Gray, S. R. Pelling, Laboratory Assistants, were on duty throughout the year.

Mr. J. R. McQueen proceeded on vacation leave on the 25th May, and returned to duty on the 21st December.

Mr. W. P. Bruce returned from vacation leave on the 6th August, and Mr. J. Forsyth proceeded on vacation leave on the 21st October.

Mr. G. M. Eames, Overseer, was on duty throughout the year.

Mr. O. Stenmark, Mechanic, returned from vacation leave on the 24th May.

Mr. J. H. Crampton, Accounts Clerk, was on duty throughout the year and carried out the duties of Acting Laboratory Superintendent during Mr. Kemp's absence on leave.

Mr. D. Dewar, Clerk-Librarian, returned from vacation leave on the 9th February, and was transferred to the staff of the King's African Rifles, Nairobi, with effect from the 17th October.

Miss Gent-Wood, Clerk, Head Office, Nairobi, was transferred to the Laboratory and took over the duties of Clerk-Librarian from Mr. Dewar, with effect from the 9th December.

Mr. Clochley, Storekeeper, returned from leave on the 2nd September, 1935.

Miss R. M. Dennis and Miss J. K. Middleton, Clerks, were both on duty throughout the year.

Miss Rushworth was transferred from the Agricultural Department, Amani, Tanganyika Territory, with effect from the 16th September. This appointment filled the vacancy created by the departure of Miss A. J. Ker on the 1st June.

Mr. Derek North-Lewis, Laboratory Student, was on duty throughout the year. Three Laboratory Students relinquished their appointments, viz., Miss B. C. Holmes, with effect from the 1st February, Mr. J. A. Edwards, from the 4th May, and Mr. B. K. Roberts, from the 13th July.

The following two new appointments were made as a result of the vacancies created, Mr. D. H. McCalman, with effect from the 23rd April, and Mr. T. K. Hill, from the 8th July.

Mr. M. H. French, Biochemist, from Mpwapwa, visited the Laboratory, Kabete, and Government Farm, Naivasha, during July, 1935. Through the courtesy of Mr. H. E. Hornby, the Director of Veterinary Services, Tanganyika Territory, he was able to make a series of carcass and organ weight tests on samples of grade and native cattle killed at the Nairobi Abattoir. The results of his investigations, which

were published in the *Empire Journal of Experimental Agriculture*, have proved of great value to the Meat and Live Stock Inquiry Committee.

Dr. A. C. King, of London, was a visiting worker at the laboratory from March to June. Dr. King was engaged on cancer research and left the country satisfied with the progress that he had made. Quantities of extract for the experimental treatment of carcinoma have from time to time been prepared at the laboratory and despatched to Dr. King in England.

It is with pleasure that I take this opportunity of placing on record my appreciation of the satisfactory manner in which the members of the staff have carried out their duties during the year.

CORRESPONDENCE.

4,629 inward and 3,171 outward letters and telegrams, a total of 7,780, received attention during the year.

In addition, 5,369 slides and specimens were examined and reported upon. A classification of these reports is shown under "Technical Routine".

LABORATORY WORKSHOPS.

No new buildings were erected at Kabete during the year by the Public Works Department. A divisional warrant for £120 was allocated from the Public Works Department vote for the maintenance of laboratory staff buildings.

The steam, gas and cold storage plants were in use throughout the year. The two laboratory water supply pumps and the numerous small electrical units gave satisfactory service. Maintenance work and minor repairs were carried out by the workshops staff. There is a shortage of water storage accommodation and a need for a larger pipe-line from the mains, which it is hoped will receive attention when the financial position permits.

General repairs were effected to laboratory, boma and staff buildings, and several staff bungalows were repainted throughout. Three of the laboratories and offices were thoroughly overhauled and repainted.

Two quarantine buildings for dogs were erected, and four all-metal pig isolation houses were constructed. The old incubator room was insulated and fitted with an efficient electric heating system. A fume cupboard was made and installed.

Several tsetse-fly traps, breeding cages, and cattle feeding troughs were made. The transport vehicles, farm implements and laboratory fences were kept in good repair.

FINANCE.

The sanctioned expenditure for the year was £22,869 compared with £21,625 for the year 1934. Production of sera and vaccines was maintained in sufficient quantities to meet demands, but at the end of the year the reserve stock of anti-rinderpest serum had decreased by 34,265 units to 8,065 units only. It is becoming increasingly difficult, however, to maintain the level of production and at the same time to keep within the sanctioned expenditure. The revenue collected for the year from the sales of sera, vaccines and laboratory products amounted to £2,835/19/84, as compared with the estimated figure of £3,000. This figure is exclusive of revenue derived from rinderpest double-inoculations carried out by the field staff, such collections being paid into veterinary inoculation fees. The value of anti-rinderpest serum issued to the field staff at the scheduled rate of Sh. 2 per unit of 50 c.c. was £18,159.

The sale of hides realized £136, and £3 was derived from the sale of vaccinating materials.

TECHNICAL ROUTINE.

The following list shows the origin of the slides and specimens submitted to the laboratory for examination and report during 1935 :—

SLIDES AND SPECIMENS SUBMITTED TO THE LABORATORY, 1935

Avians (Ducks)	3
„ (Fowls)	71
„ (Turkeys)	8
Arsenic Tests	15
Bovines	4,556
Canines	142
Caprines	36
Crocodiles	8
Equines (Donkeys)	1
„ (Horses)	185
Flies	9
Jackals	9
Milk Specimens	31
Miscellaneous Game	53
Ovines	150
Plants	3
Porcines	18
Rabbits	17
Ticks	50
Worms	4

TOTAL ..	5,369
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THE CLASSIFICATION OF THE DIAGNOSES IS AS FOLLOWS :

AVIAN (Duck)	Total examined	3
Negative	3	
AVIAN (Fowls)	Total examined	71
Fowl Typhoid	21	
Fowl Pox	3	
Helminthiasis	7	
Miscellaneous	20	
Negative	20	
AVIAN (Turkeys)	Total examined	8
Fowl Typhoid	2	
Fowl Pox	1	
Miscellaneous	3	
Negative	2	
ARSENIC TESTS	Total examined	15
Positive Tests	5	
Negative Tests	10	
BOVINES	Total examined	4,556
Anaplasmosis	186	
Anthrax	25	
Bacillary Necrosis	1	
Blackquarter	10	
Contagious Abortion Tests	2,299	
East Coast Fever	340	
Hæmorrhagic Septicæmia	7	
Heartwater	12	
Paratyphoid	14	
Pleuro-pneumonia	5	
Redwater	35	
Small Piroplasms	59	
Trypanosomiasis	14	
Miscellaneous	30	
Negative	1,519	
CANINES	Total examined	142
Helminthiasis	20	
Rabies	10	
Suspected Rabies	2	
Tick Fever	12	
Trypanosomiasis	2	
Miscellaneous	25	
Negative	71	
CAPRINES	Total examined	36
Contagious Abortion	2	
Heartwater	2	
Pleuro-pneumonia	3	
Miscellaneous	19	
Negative	10	
CROCODILE	Total examined	8
Haemogregarina	8	
EQUINES (Donkeys)	Total examined	1
Negative	1	

EQUINES (Horses)	..	..	Total examined	185
Anthrax	..	..	..	4
Contagious Abortion	..	..	..	23
Helminthiasis	..	..	..	14
Streptothricosis	..	..	..	3
Ulcerative Cellulitis	..	..	..	12
Miscellaneous	..	..	..	19
Negative	..	..	..	116
FLIES	..	..	Total examined	9
Specimens	..	..	..	9
JACKALS	..	..	Total examined	9
Rabies	..	..	..	6
Negative	..	..	..	3
MILK	..	..	Total examined	31
Specimens	..	..	..	31
MISCELLANEOUS GAME	..	..	Total examined	53
Negative	..	..	..	53
OVINES	..	..	Total examined	150
Anthrax	..	..	..	15
Contagious Abortion	..	..	..	1
Blackquarter	..	..	..	5
Heartwater	..	..	..	2
Helminthiasis	..	..	..	45
Streptothricosis	..	..	..	32
Miscellaneous	..	..	..	35
Negative	..	..	..	51
PLANTS	..	..	Total examined	
Specimens	..	..	..	3
PORCINES	..	..	Total examined	18
Swine Fever	..	..	..	10
Helminthiasis	..	..	..	3
Miscellaneous	..	..	..	3
Negative	..	..	..	2
RABBIT	..	..	Total examined	17
Negative	..	..	..	17
TICKS	..	..	Total examined	50
Specimens	..	..	..	50
WORMS	..	..	Total examined	4
Specimens	..	..	..	4

CONTAGIOUS ABORTION TESTS

TOTAL EXAMINED	..	..	2,325
BOVINES	..	..	Total examined 2,299
Positive	..	..	.. 359
Doubtful	..	..	.. 83
Negative	..	..	.. 1,857
CAPRINES	..	..	Total examined 2
Negative	..	..	.. 2
EQUINES	..	..	Total examined 23
Negative	..	..	.. 23
OVINES	..	..	Total examined 1
Negative	..	..	.. 1

LIVE STOCK.

The following table shows the number of live stock, other than small animals and poultry, which were shown in the laboratory stock ledgers during the year. These figures include animals sent by or purchased from stockowners for experimental purposes, or for use in the preparation of laboratory products.

SPECIES	On Hand 1-1-35	Increase	Decrease	On Hand 31-12-35
Horses	9	45	25	29
Mules.. ..	20	3	1	22
Cattle	741	902	788	855
Sheep	64	219	203	80
Goats.. ..	7	4	4	7
Donkeys	Nil	1	Nil	1
Pigs	2	279	281	Nil
Buffalo	1	Nil	Nil	1

LABORATORY PRODUCTS.

Anti-Rinderpest Serum.

Serum production was maintained throughout the year.

The stock of serum on hand at the commencement of the year was 42,330 50 c.c. units; the quantity manufactured during the year was 144,190 50 c.c. units, and 3,140 50 c.c. units were returned to the laboratory; a total of 189,660 50 c.c. units.

Issue of anti-rinderpest serum to the field staff and stock-owners during the year totalled 181,595 50 c.c. units, leaving a balance in stock at the end of the year of 8,065 50 c.c. units.

It will be seen that the serum production figure for 1935 was below actual demands; the deficit was supplied from stock brought forward from 1934 production.

PREPARATION AND ISSUES OF VETERINARY PRODUCTS FOR THE YEAR ENDING 31st DECEMBER, 1935

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Products	Balance on Hand 31-12-34	Prepared at Laboratory	Returned to Laboratory	Issued to Field Staff and Stock-owners	Issued to Other Countries	Total Issues 1935	Balance on Hand 31-12-1935
Anthrax Vaccine (single spore)	Nil	16,097	Nil	16,097	—	16,097	Nil
Blackquarter Vaccine ..	Nil	43,341	Nil	43,341	—	43,341	Nil
Bluetongue Vaccine ..	5,400	6,195	Nil	11,595	—	11,595	Nil
Colon Bacillosis Vaccine ..	183	3,363	Nil	3,546	—	3,546	Nil
Contagious Abortion Vaccine ..	Nil	1,193	Nil	1,193	—	1,193	Nil
Fowl-pox Vaccine ..	Nil	9,526	Nil	9,526	—	9,526	Nil
Fowl Typhoid (K.F.D.) Vaccine ..	Nil	20,873	Nil	20,873	—	20,873	Nil
Horse-sickness Vaccine ..	Nil	853	Nil	853	—	853	Nil
Pleuro-pneumonia Vaccine ..	Nil	614,941	Nil	614,941	—	614,941	Nil
Paratyphoid Vaccine ..	Nil	2,386	Nil	2,386	—	2,386	Nil
Paratyphoid Feed Vaccine ..	Nil	3,122	Nil	3,122	—	3,122	Nil
Redwater and Anaplasmosis Vaccine ..	Nil	225	Nil	225	—	225	Nil
Rinderpest Vaccine ..	Nil	31,673	Nil	30,193	1,480	31,673	Nil
Serum, Anti-rinderpest ..	42,330	144,190	3,140	181,595	—	181,595	8,065
Sheep-pox Vaccine ..	Nil	630	Nil	630	—	630	Nil
Sodium Tellurite..	Nil	7,844	Nil	7,844	—	7,844	Nil
Trypanblue Bovine ..	219	20	Nil	239	—	239	Nil
Trypanblue, Canine ..	46	83	Nil	129	—	129	Nil
Tartar Emetic ..	Nil	155,800	Nil	155,800	—	155,800	Nil
Wireworm Remedy Powder ..	349,800	618,200	Nil	649,900	—	649,900	318,100

Anti-rinderpest Serum	Field Staff ..	181,195	units of 50 cc.
Stockowners	..	400	"
Other Countries	..	Nil	"
Total Issues, 1935 ..	..	181,595	"

RESEARCH.

Rinderpest.

Reference has been made in previous reports to experiments designed to test the duration of the immunity provoked in cattle by the vaccine-plus-virus inoculation.

The most important point in this connection is to ascertain whether those animals that failed to react to the virus inoculation acquired any increased degree of immunity beyond that conferred by the preliminary inoculation with vaccine. In November, 1932, 1,180 cattle were inoculated on an outlying farm in the Rumuruti district. The cattle were divided into three lots and given different treatments. Lot I received a dose of vaccine containing 2 grammes of spleen pulp, followed by 5 c.c. of a centrifuged extracted spleen virus equal in virus content to $2\frac{1}{2}$ c.c. of vaccine. Lot II received vaccine equivalent to 3 grammes of spleen pulp, followed by 5 c.c. of the extracted virus. Lot III were treated with 3 grammes of spleen pulp as vaccine, followed by 15 c.c. of the extracted spleen virus. The interval between the inoculations was 14 days. Temperature records were kept of 249 animals during a period of 14 days following the inoculation of virus. The temperature-recorded group included 100 animals of Lot I, and of these 33 showed temperature reactions after the inoculation of virus; of Lot II 99 animals were recorded, of which 22 showed similar reactions; and of Lot III 50 animals were recorded and 14 showed reactions.

A random sample was collected for testing 2 years and 5 months after vaccination. The sample included 79 animals of Lot I of which 30 were numbered animals whose individual temperature records at the time of vaccination were available.

Of the 30 numbered animals, 3 only reacted to the virus inoculation and none of these 3 had reacted to the original inoculation of virus at the time of vaccination. Of the remaining 49 animals of this lot 19 reacted to the test inoculation: making a total of 20 reactions out of 79 animals tested, or 25.5 per cent.

Of Lot II 80 animals were tested and of these 30 were numbered animals. Of the 30 numbered animals 12 reacted, and reference to the earlier records showed that only one of these 12 had given a definite reaction to the inoculation of virus at the time of vaccination. In the remaining 50 animals of Lot II, there were 19 reactions, bringing the total percentage of reactors in this batch to 39.

Of Lot III only 10 animals could be collected for testing, all of which were numbered animals whose temperatures had been recorded at the time of vaccination. Of these 10 animals 2 gave extremely mild temperature reactions, one lasting three days and the other one day. Neither of these animals had given any reactions to virus at the time of the original inoculation.

If a comparison is made between Lot I and Lot II it is evident that the increased dose of vaccine employed in Lot II resulted in the production of reactions in a smaller percentage of the cattle when the immunizing dose of virus was inoculated—22 per cent as against 33 per cent. When the test dose was given the Lot II animals showed a higher percentage of reactions—39 per cent as against 27.5 per cent in Lot I. This result indicates that although it may not be necessary for a temperature reaction to occur after the virus is inoculated in the vaccine-plus-virus method, it is necessary for actual infection to take place if the immunity is to be rendered permanent. The higher dose of vaccine results in a larger number of completely blocked-out reactions with a corresponding loss of immunizing effect. The numbers of Lot III tested here are insufficient to enable one to draw conclusions.

Further information is, however, available in the record of a natural infection that occurred in a herd of these experimental animals as a result of the presence of infected eland. The herd in question was made up of 317 animals of Lot I, 75 animals of Lot II and 50 animals of Lot III, and the outbreak occurred four months after the test referred to in the preceding paragraph, that is, two years and nine months after the vaccination. None of the animals had been tested or exposed to infection during the intervening period. The incidence of the disease in the different groups was as follows:

Lot I.—Of 317 animals, 2 contracted very mild attacks of rinderpest followed by rapid recovery.

Lot II.—Of 75 animals, 15 contracted rinderpest, 10 severely; but all recovered.

Lot III.—Of 50 animals, none was observed to show any symptoms of rinderpest.

The statement refers to clinical rinderpest since temperature records were not kept.

The incidence of reactions in this natural outbreak confirms the finding in the experimental test. Lot I treated with a smaller dose of vaccine and having shown a higher percentage of reactions at the time of vaccination had a significantly

higher resistance to infection two and three-quarter years later. Lot III which received a vaccinating dose of virus at the time of vaccination were solidly immune two years and nine months after vaccination.

The result of this test coupled with small-scale laboratory experiments has led us to adopt a vaccinating dose of virus in all vaccine-virus inoculations. In a similar test that was carried out on 128 animals that had been immunized by the ordinary serum-virus simultaneous method two years previously, 12 animals showed slight temperature reactions after the usual testing with virus, but the reactions were noticeably milder and of shorter duration than those in the vaccine-virus treated animals in the experiment referred to above. It has been shown in laboratory experiments that it is possible by the use of a serum of an extremely high titre to block out reactions to virus in double-inoculation, and that animals so inoculated again become susceptible to infection as soon as the serum-immunity has disappeared.

The situation with regard to the vaccine-virus method of immunization appears to be entirely comparable. It is possible, however, to adjust two factors just as it is in serum-virus inoculations. One may vary the dose of vaccine and one may vary the dose of virus to ensure that all animals actually acquire infection from the virus inoculation.

Horse Sickness.

During the year it was learned that du Toit and Alexander, working at Onderstepoort, had carried "O" virus through a large number of passages in the brains of mice and had been able to prepare a safe vaccine for the immunization of horses. Two other South African viruses had been similarly attenuated. Our own "O" virus had reached its 90th passage in the brains of mice and was undoubtedly showing signs of attenuation for horses. It had already been employed in a considerable number of vaccinations in the field in combination with the ordinary formalized tissue vaccine. The dose of the formalized vaccine had been reduced to half and a final inoculation of the neuro-virus was then given. Through the courtesy of Dr. du Toit we were able to obtain the more attenuated strain of older passage from South Africa, and, after testing, this method was adopted as a routine in the latter part of the year, 686 doses being issued.

The method is considerably cheaper than the old formalized vaccine method, and the amounts to be inoculated are quite

small. It was the larger quantity of material that had to be injected which perhaps constituted the greatest disadvantage of the older method.

No breakdowns of immunity were reported before the end of the year in horses vaccinated by the new method, but it is quite possible that we shall hear of breakdowns in the near future. It is the intention to collect virus from any vaccinated horses that may die of apparent horse sickness, and as far as possible to examine each strain with a view to the detection of strains of virus that are not at present included in the vaccine.

During the year Mr. Fotheringham has been able to study the value of histological methods in the diagnosis of horse sickness. Although mice are susceptible to the virus, they do not offer us a means of obtaining a rapid and certain diagnosis owing to the difficulty of establishing the virus in mice in its early passages. Mr. Fotheringham has shown that hyaline bodies can be detected in certain cells in the liver and kidney of an animal dead of horse sickness. The hyaline changes in this disease resemble those of yellow fever of man to a striking degree, and to some extent are similar to those described in Rift Valley fever. He proposes to publish a short note on the diagnosis of the disease by this method.

Malignant Catarrh of Cattle.

During the year we were fortunate enough to obtain a readily transmissible strain of this virus. References were made in the Annual Report for 1933 to transmission experiments with malignant catarrh. The strains under examination at that time were obtained from farms so situated as to preclude any possibility of contact between cattle and wildebeest; and the disease transmitted by blood inoculation, although marked by the typical symptoms of malignant catarrh, was never a serious condition clinically and none of the experimental animals died. Of five strains investigated, the infection in each case died out before the third passage in experimental animals. Attempts to infect rabbits with these strains were unsuccessful.

The 1935 strain is of a much more virulent type and is readily transmissible by blood, gland and brain inoculation. The actual origin of the strain is uncertain, since the disease was first diagnosed in a calf that had been exposed to possible contact infection, both from an ox suffering from the disease, and also from a young apparently healthy wildebeest calf.

Starting with the spontaneous case of snotsiekte or malignant catarrh in this calf, we have studied the course of this disease in 33 artificially infected cattle, in all of which the infection terminated fatally. Infection has been successfully transmitted by subcutaneous inoculation of large quantities of defibrinated blood taken during the febrile period, by intraglandular inoculation of suspensions of brain or lymphatic gland pulp, and in a single instance by simple contact.

The average incubation period in the 33 cattle has been 20.9 days, with a maximum of 60 days and a minimum of 14 days. Of the 33 animals that reacted to the inoculation all died. Two animals have failed to react. The incubation period for experimentally transmitted cases of what we have termed the "head and eye" form of the disease as represented by the 1935 strain has been similar to that recorded by Mettam for snotsiekte in South Africa and that found by Goetze in Europe for this form of malignant catarrh. The lack of uniformity between different strains in respect of their transmissibility to cattle must go far to reconcile the divergencies of opinion on this subject among workers in Europe.

The more intensive study of malignant catarrh which has been made in Europe during the last ten years has resulted in considerable additions to our knowledge of the pathology, etiology and clinical features of the disease in cattle; and in the light of these advances the characters that caused Mettam (1923) to describe snotsiekte as an independent disease are no longer valid, and snotsiekte must become a synonym of malignant catarrh.

The experimentally-produced disease has not been readily transmissible by contact, but one case of contact infection has been seen in a calf; and it is pointed out that, in view of the short-interval dipping practised at the laboratory, the possibility of ectoparasites playing any effective role in transmission can be discounted.

The disease has been transferred from cattle to rabbits—not once, but seven times out of ten attempts; in six of them by subdural inoculation of brain tissue, and in one by intraperitoneal inoculation of blood. In the early rabbit passages the lesions in the kidney, liver and brain are identical, both macroscopically and microscopically, with those seen in cattle. In later passages the infective agent appears to become increasingly neurotropic, and there is a corresponding reduction in the severity of the visceral lesions. In an effort to retain the

viscerotropic characteristics of the original virus, we have attempted to establish an intraperitoneal strain in rabbits. This strain is now in its fifth passage.

For the first time the disease has been satisfactorily reproduced in cattle in typical fatal form by the inoculation of material derived from rabbit passages. Two cattle died out of four inoculated with brain from rabbits of the third subdural passage. None of the inoculated rabbits has shown the symptoms regarded as characteristic of Borna infection in this species, nor have the corpuscles of Joest-Degen been found in the central nervous system.

With regard to the suggestion of German workers that the disease is immunologically related to, or even identical with, Borna disease, we are at the moment arranging to carry out direct immunity tests with the two viruses, but in the meantime we are disposed to agree with Goetze that it is unlikely that the two diseases are identical. The most striking difference between our findings in rabbits and those of Ernst and Hahn and Zwick and Witte is in the production in the earlier passages of our strains of visceral lesions readily recognizable with the naked eye. It is unlikely that such lesions could have been overlooked by experienced workers had they occurred in the German experiments. Our strain, as already stated, reproduces typical malignant catarrh in cattle, whereas in the animal inoculated by Zwick and Witte with brain from the sixth subdural passage of their rabbit strain, the clinical condition bore a greater resemblance to Borna disease than to malignant catarrh. It is possible, however, that the atypical syndrome described by these authors might in part be due to the fact that the virus had undergone a greater number of passages in rabbits before it was returned to cattle, and in part to the employment of the intracerebral method of inoculation.

Our experiments with sheep, guinea-pigs and mice are not yet sufficiently advanced to be included in this note, but we are inclined to believe that we have succeeded in transferring the disease to sheep in a mild form, and we have certainly succeeded in transmitting the "head and eye" strain to the other two species.

At the end of the year a paper by R. Daubney and J. R. Hudson was being prepared for publication.

Swine Influenza.

During the year there was a widespread epizootic of swine influenza in the Colony. The attention of the laboratory was first drawn to the disease by reports of an alarming outbreak of what appeared to be highly-contagious disease of swine in the Elburgon district. More than 90 per cent of the pigs on the infected premises were affected by the disease, which was characterized by coughing, stiffness of the muscles and joints, and extreme prostration. Three animals were sent to the laboratory for diagnosis and on post-mortem examination they were found to have the typical atelectatic lung lesions of swine influenza as described in America by Shope. The tentative diagnosis was confirmed by the rapid recovery of the great majority of pigs on the infected farm, the mortality amounting to less than 2 per cent.

Since swine influenza had not previously been recorded in Africa, experiments were undertaken to identify the disease. The disease was readily transmissible by the intranasal route, and pigs could be infected by intranasal inoculations with suspensions of ground-up atelectatic lung tissue or by similar inoculation with nasal washings from infected animals. There was no difficulty in reproducing the characteristic lesions in mild form by intranasal injection of Seitz, Berkefeld and Chamberland filtrates of lung tissue. Investigation of the bacterial flora of the lungs of infected animals resulted in the isolation of numerous strains of the influenza bacillus, *Haemophilus influenzae suis*; at times in pure culture and at times in association with other organisms, chiefly bi-polar bacilli and diplococci of the type referred to by Spray as *Streptococcus lanceolatus*.

Although from time to time severe cases of the disease were produced by artificial inoculation, it was never possible to demonstrate any enhancement of the pathogenic action of the virus through the addition of any of the commonly isolated bacteria. The bacteria alone proved apathogenic.

It is of interest to record that in a number of cases *Haemophilus influenzae suis* was, contrary to American experience, isolated from the lungs of apparently healthy swine, as well as from the lungs of pigs that were suffering from the usual pneumonic changes consequent upon the migration of the larvae of the *Ascaris lumbricoides*.

A further point of interest is that we were able to infect cattle by intranasal inoculation with suspensions of pig lung; and the disease set up in cattle would spread spontaneously by

contact both to cattle and pigs. The disease in cattle was extremely mild with a short febrile period and a muco-purulent discharge from the nose lasting in most cases three or four days only. Lung lesions were never produced by intranasal inoculation in cattle.

As a result of frequent inspection of the lungs of animals slaughtered at the Nairobi abattoir, we reached the conclusion that the outbreak was extremely widespread throughout the Colony. On occasion more than 80 per cent of the lungs of pigs slaughtered during one week would be condemned for pneumonic lesions of the swine influenza type. We recovered virus several times by inoculation with material collected at the Nairobi abattoir and repeatedly isolated the typical bacteria.

Later in the year our attention was drawn to a farm where extremely heavy losses had occurred among sucking pigs. Over a period of months the mortality in litters had exceeded 70 per cent. Examination of affected piglets revealed the characteristic lesions of swine influenza or *ferkelgrippe* as recently described by German workers. In Germany *ferkelgrippe* has been considered as a form of swine influenza; but it has never been possible to transmit the disease to healthy pigs or to produce any lung lesions by the inoculation of filtrates of lung tissue, or of combinations of filtrates with bacteria including *Haemophilus influenzae suis*, which is commonly found in the lungs of affected piglets.

Contrary to German experience, we have been able to transmit this strain of virus by means of filtrates and by combinations of filtrate and bacteria; and in larger pigs, such as we have used in our experiments, the disease has presented the same characteristics as the clinical American swine influenza.

This is a highly contagious disease, and experiments were considerably hampered by the lack of proper isolation accommodation; it was impossible to carry out more than a strictly limited number of experiments at any one time. A little extra suitable accommodation has now been provided, and it is hoped to take up this work again as soon as opportunity offers.

A strain of virus was obtained from America and it is proposed to compare Kenya virus with the American strain. It is interesting to remark that the virus of swine influenza as isolated in America appears to be closely related to that of human influenza; and indeed many adults in England, according to the work of Laidlaw, Andrews and Smith, carry antibodies for the swine influenza virus in their blood.

East African Swine Fever.

During the year several outbreaks of this disease occurred in various parts of the settled area. Attempts to demonstrate the carriage of the virus by apparently healthy wart-hog or bush-pig collected in the vicinity of outbreaks have so far been uniformly negative.

An Undescribed Virus Disease of Cattle.

During the year Mr. Danks succeeded in transmitting a disease of cattle that had for some time been known to exist on a farm situated quite near the laboratory. Cases of the disease occur sporadically on the farm in question, and the majority of infected animals recover. Probably the mortality is not higher than 5 or 6 per cent. In fatal cases the most striking lesions are extensive sub-serous and sub-mucous hæmorrhages. The hæmorrhages are not massive, but consist of aggregations of fairly small petechiae. They may be present in any organ, but are perhaps most noticeable on the epicardium and endocardium. Clinically, the disease bears some resemblance to the condition described by Mettam as Nairobi quarantine disease, but Mettam failed to transmit this disease in his work at Kabete.

In addition to cattle, sheep, dogs and rabbits contract the experimental infection, but horses, pigs and guinea-pigs are relatively resistant. The infective agent can be preserved for a few days at cold-room temperatures in the form of virulent blood, but failed to survive as long as thirteen days.

The experimental work is as yet incomplete.

A Disease of the Newcastle Type in Fowls.

Towards the end of the year our attention was drawn to the occurrence of a highly-fatal epizootic disease of fowls on the Island of Mombasa. All the affected birds died and the disease ran rapidly through the flock once it had become established.

From a bird forwarded to the laboratory Mr. Hudson was able to recover a filterable virus of the Newcastle type. The disease proved to be transmissible by contact, by blood or brain inoculation, and by the intratracheal instillation of exudate from the trachea or mouth of sick birds.

Mortality in experimentally infected fowls was extremely high and in experimentally infected fowls and pigeons the disease conformed in all respects to the description given by Doyle of Newcastle disease.

Contagious Bovine Pleuro-Pneumonia.

A paper was published during the year recording the results of the work on experimental transmission during the years 1933 and 1934.

The difficulty that has been experienced in infecting animals artificially with pleuro-pneumonia in laboratory experiments has led one to consider the possibility of the existence of some second etiological factor which might be responsible for its rapid spread during large outbreaks in the field. A filtrable virus infection, mild in itself, might possibly act as the starting point for the bacterial infection.

It has been observed that cattle occasionally suffer from what is apparently a common cold spreading as an epizootic, and in a recent outbreak of pleuro-pneumonia there was a history of such an epizootic occurring quite shortly before the appearance of pleuro-pneumonia. Out of five animals slaughtered in the pleuro-pneumonia outbreak in question, four were found to have atelectatic areas in the anterior lobes of the lung, and experiments were undertaken to ascertain whether any disease was transmissible by intranasal inoculation with material from these atelectatic areas. Nothing recognizable as a disease has been transmitted, either with filtered or unfiltered suspensions; and, as already stated, cattle infected intranasally with swine influenza virus failed to show any lung lesions at all. Nevertheless, cattle were inoculated intranasally with mixtures of the swine influenza filtrate and cultures of the contagious bovine pleuro-pneumonia organism on several occasions. In some cases the two agents were administered simultaneously, and in others the administration of the organism was delayed until the cattle reacted to the influenza filtrate; but in no case was it possible to reproduce the disease.

Mastitis.

During the year Mr. Danks has continued his routine investigation of outbreaks of mastitis in dairy herds, isolating and determining the species of bacteria present in the milk of infected cows. Most of the outbreaks have been treated either with stock or autogenous vaccines.

Entero-toxæmic Diseases of Sheep.

Sporadic cases of entero-toxæmia continued to occur on certain sheep farms. Strains of *C. welchii* were isolated from affected animals, and the toxicity of the filtered intestinal

contents for mice was demonstrated in several cases. The organisms isolated all failed to produce toxin in the usual laboratory media, but investigations are being continued.

On one large farm cases of lamb dysentery occurred towards the end of the lambing, but fortunately the majority of lambs were at that time too old to be susceptible. *C. welchii* was again isolated from this outbreak and also from another small outbreak in which the losses were not heavy.

Calf Diseases.

On certain farms calves suffered during 1935 from what amounted almost to an epizootic of pneumonia. No specific organisms could be isolated from the lungs of affected animals, but we are carrying out field investigations with vaccines prepared from pathogenic bacteria that have been isolated from the diseased tissues.

Streptothricosis.

Mr. Hudson has studied the organism of the so-called streptothricosis of sheep and cattle, and has made experiments in the transmission of the disease. The organism is very closely related to that isolated from the lesions of "lumpy wool" in Australia and South Africa. Clinically the disease called streptothricosis is quite distinct. "Lumpy wool" is always associated with a long fleece and wet weather conditions, and in an attempt to infect sheep with the Kenya organism, moist pads infected with culture have been retained on the backs of sheep for prolonged periods, but without any success.

It is possible that, as in the case of cattle, this organism attacks only those sheep whose vitality is lowered by some other factor such as a nutritional deficiency or an attack of a debilitating disease. As already stated, the organism in the smears made from the lesions of natural cases is indistinguishable from the organism of "lumpy wool". This statement also applies to the organism in culture. Rabbits are susceptible to inoculation by rubbing scabs or cultures on areas of skin from which the hair has been plucked, and the lesion so produced conforms in every way to the description of the lesions that follow inoculation of the "lumpy wool" organism into rabbits.

East Coast Fever.

Continuing the programme of the work laid down by the first Conference on Co-ordination of Veterinary Research (1934), the capacity of ticks other than *Rhipicephalus appendi-*

culatus to transmit East Coast fever has been under investigation by Mr. Fotheringham and Dr. Lewis. In a re-examination of all the possible vectors normal transmission of the disease has been effected by *R. appendiculatus*, *R. simus* and *R. evertsi*. The following species have to date failed to transmit the disease under carefully controlled conditions: *Amblyomma variegatum*, *Rhipicephalus pulchellus*, and *Rhipicephalus sanguineus*. A new experimental vector has been discovered in *Hyalomma aegyptium impressum*, which has transmitted in the nymphal and adult stages. The disease transmitted by this species has in one case presented certain peculiarities. The temperature reaction was unusually protracted, lasting for twenty-two days before the infection terminated with the death of the animal. During the period of the reaction Koch's bodies were confined almost entirely to the subauricular lymphatic gland on the same side as that on which the ticks were fed. This condition persisted until shortly before death, when a general spread occurred. Meanwhile the infection of red cells had progressed to such a stage that anæmia developed as a result of destruction of parasitized cells. It is possible that a further study may bring to light factors that are responsible for much of our difficulty in diagnosing East Coast fever in certain atypical outbreaks where the percentage of recoveries is high.

In connection with the programme of work on East Coast fever, Dr. Lewis is enlarging the scope of his tick-survey by making a survey of seasonal fluctuations in the total numbers of ticks and in the comparative frequency of the different instars. In this survey he has included areas as nearly as possible typical of all types of climatic and soil conditions in the country. The field work is being supplemented by laboratory studies on the bionomics of the different species with reference to the influence of environmental changes, in particular those of temperature and humidity, upon the life cycle of the tick and upon the development of *Theileria parva* within the tick-host.

Tsetse Flies and Trypanosomiasis.

Investigations into the bionomics of *Glossina pallidipes* and experiments on the control of the fly in the Lambwe Valley, South Kavirondo, have been continued under the Colonial Development Fund grant. Regular patrols by trained fly-boys provided with hand-nets and screens for catching flies show that the greatest density of *G. pallidipes* is in Roo Valley at the lower end of the main Lambwe Valley. It is evident that the tsetses spread from Roo and establish

themselves in the Otouk bush about half-way up the Lambwe. From here the flies spread up and down the valley wherever the vegetative cover provide suitable conditions. Fly-rounds indicated that a few flies spread into otherwise fly-free areas at the upper end of the Lambwe Valley and it was therefore decided to attempt to check further spread by clearing bush to form a barrier at the foot of a small range of hills, which would also assist to obstruct the vision of flies and thus inhibit any tendency to range into uninfested areas.

Although it should be widened and extended along both east and west flanks, this barrier has had the desired effect. It serves also to isolate the *pallidipes* zone and this provides a large block of country for investigational and experimental purposes.

Intersecting corridors, cleared of bush, have been made to facilitate trapping; and numerous traps have been set. Several types of trap have been designed but only a small number have shown promise. The Shinyanga or single-screen trap is useful against *pallidipes*; the Harris or Zululand trap has proved efficient, but the best results from preliminary trials have been with a simple "box-screen" trap designed by the tsetse-fly overseer (Commander D. E. Blunt). This trap is now being tested against others in three different zones and if it continues to give such good results, it will be used still more extensively.

The effect of discriminate clearing of bush—thinning out the dense vegetation or undergrowth—is being studied; and an attempt is being made to prevent flies ranging from the primary riverine home to more open country, by planting a dense, but narrow, strip or hedge of bush parallel to the Lambwe River.

The breeding places of *pallidipes* are receiving attention. They appear to be most abundant in the riverine bush but occur also several miles from the river towards the western hills. It was thought that Ruma, a large area covered by very dense bush, was the home of the fly in the Lambwe. Fly rounds, however, show that it is only on the fringes that the flies and breeding places are numerous. Inside the dense bush catches of flies are small and pupae rather scarce. This seems to be accounted for by the extreme density of the bush in parts and the annual flooding of the area.

Observations on fluctuations in the numbers of flies caught and on the movements of game have been made. The overseer, in his report, comments upon the effect of elephant on

the catches in Otouk and reports that elephant appear to provide favourable hosts for the tsetse as shown by the small number attracted to and caught by fly-boys when elephant are in, or have recently left, the locality, and the return to normally high catches sometime later or in the absence of elephant; and that elephant do not appear to assist greatly in spreading the tsetse.

With regard to fluctuations in fly-density, population activity and dispersal, there is a sudden increase of flies in the riverine bush in June and July, and the flies show a tendency to spread over a greater part of the valley in June, July and August when they take advantage of the smallest cover to infest the small valleys in the western range of hills and on the slopes of the eastern escarpment. The wide dispersal at this period does not appear to be dependent on the movements of game, but seems to be influenced by biological or environmental conditions. Studies of these conditions will be carried out later.

Experiments on the treatment of *T. congolense* infection of cattle have been continued.

Reference was made in the last annual report to preliminary observations with the Bayer preparation "Surfen C." Surfen C has now been more thoroughly tested but there is some indication that different batches of this compound have varied in their therapeutic activity. The batch most recently received has given consistently good results and four cattle treated with doses of one gramme per 220 lb. body weight were all cured with a single injection.

Attempts to demonstrate prophylactic action against *T. congolense* infection in cattle failed. The drugs used were Surfen C, Antrypol, and Surfen C plus Antrypol. The period between inoculation of the drug and experimental infection was three weeks. The appearance of parasites was delayed, but complete prophylaxis was not obtained.

Respiratory Diseases of Sheep.

Mr. Fotheringham has continued his investigation of this group of diseases. It will be recalled that there was some question as to whether the proliferative pneumonia that occurred in this Colony was identical with jagsiekte of South Africa, or whether the characteristic lesion could be attributed to the lung-worms of the genus *Muellerius*. It is now apparent that both types of pneumonia occur in this Colony—true jagsiekte, and a proliferative and indurative pneumonia

associated with the presence of *Muellerius capillaris*; and the two conditions may even exist side by side in the same lung. Pathologically they are, however, readily distinguishable.

With regard to suppurative pneumonia, the condition originally termed Laikipia lung disease still exists in the Colony; but although the lesions found to-day are those described by Mettam, the organisms that are recoverable from the lesions are no longer the same. It is possible that the explanation of the situation is the same as that offered in South Africa to account for a similar change in the types of pneumococci associated with pneumonia in natives working in the mines of the Rand. It has been concluded there that the flora of the lungs has altered as a result of intensive immunization of the population. The organisms originally responsible for the pneumonia have, it is suggested, been immunized out, and a new group has taken their place. It is not improbable that some similar substitution of new organisms has been forced by repeated immunizations against Laikipia lung disease. Although we still have the disease, with its characteristic pathological picture, the organisms recoverable from the lesions are no longer those of the original description. At the present time the practice is to carry out an exhaustive bacteriological examination of several cases from each outbreak that is notified, and the vaccine in each instance is prepared from organisms isolated from animals affected on the particular farm.

With reference to infections of the lungs with caseous lymphadenitis there has been some confusion in the past, owing to the habit of farmers to class all suppurative types of pneumonia as Laikipia lung disease. The result of the survey of respiratory diseases has been to show that caseous lymphadenitis affecting the lungs is a much more common condition than has formerly been realized. It is particularly prevalent in older sheep. On most farms one gains the impression that there is a high death-rate from respiratory diseases; but on examination it will be found that most of the animals concerned are old ewes, suffering from chronic lung lesions, which render them liable to die suddenly when exposed to adverse conditions, such as inclement weather. There is no doubt that infection with caseous lymphadenitis forms a large proportion of these respiratory cases, and that the disease is becoming more serious. Possibly in the near future, legislation may be introduced in an attempt to control the spread of the disease, since it is a matter of considerable importance to any country that contemplates the organization of an export trade in meat.

Sweating Sickness and Blacktongue of Dogs.

Blacktongue of dogs was produced experimentally in order that the disease might be compared with sweating sickness of calves. The diet utilized was similar to that prepared by Goldberger. Liver extract prepared at Kabete is fully potent in the cure of blacktongue.

An attempt to produce a similar condition in calves by feeding a modified blacktongue diet failed owing to the production of intestinal disorders.

The blood changes and inorganic blood chemistry in blacktongue and sweating sickness were closely compared, but they failed to give any help in the solution of the problem.

Blood-Mineral Estimates.

A start has been made upon a programme which contemplates a survey of blood-mineral levels in cattle and sheep in various parts of the Colony. This work will be continued probably for two years.

EXPERIMENTAL STATION, NAIVASHA.

1935 is the first year in which the Government Farm Station has functioned as a research station under the guidance of the Chief Veterinary Research Officer and, in order that the reports may in future conform with those of the laboratory, it has been decided to submit a brief report of the first nine months' working under the new grant.

Dr. J Anderson assumed duty as Veterinary Research Officer in charge of the station on his return from leave on the 4th June, 1935.

Mr. J. A. Blundell was appointed farm manager on the 1st October, 1935. Mr. C. R. Coulson, farm manager, resigned his post on the 30th June, 1935, and the appointment of assistant farm manager, held by Mr. K. S. Smith, was terminated on the 31st July.

The scheme for the reorganization of the research station was drawn up by the Chief Veterinary Research Officer and submitted to the Colonial Advisory Council for Agriculture and Animal Health. The scheme was approved in its main details and a grant was subsequently obtained from the Colonial Development Fund for the establishment of the station and its maintenance for a further period of five years from the 31st March, 1935.

The main purpose of the scheme was to give the station a definite orientation in the direction of pure research upon nutritional and genetic problems of economic importance to the East African group of colonies; and to investigate wherever possible the interaction of the two factors upon the problem of reproduction in domesticated animals.

A grant of £2,200 per year has been made from the Colonial Development Fund for a period of five years. A financial statement for the nine months ending the 31st December is given in Appendix I.

Research.

General.

A laboratory and a small animal house have been built, and a pump and engine installed to pump water from the river to the laboratory. A Silverlite gas plant has been fitted in the laboratory and is working very satisfactorily.

There was neither suitable housing nor paddocks for experimental animals when the farm was taken over and these are being provided as rapidly as possible, but it will take some time before they can be completed.

The commencement of experimental work was considerably delayed by the absence of a farm manager during August and September, when the Veterinary Research Officer's time was fully occupied with ordinary farm duties; also, it was some time before the laboratory equipment arrived from England. Notwithstanding these unavoidable delays, however, it has been possible to commence certain experiments.

Fertility in Cattle and Sheep.

At present very little is known about the normal fertility of the various types of cattle and sheep in Kenya. It is proposed to make a statistical examination of such breeding records as are available. A start has been made with the records of the grade herd of cattle on the experimental station.

Oestrous Cycle in Cattle.

From previous observations it is known that the duration of oestrus in Zebu animals is very brief, but it is not clear whether this should be attributed to nutritional deficiencies in the pasture or to breed characteristics. The observations commenced at Sangalo have been continued at the experimental station. Analysis of the pasture on the station, made some years ago by workers from the Rowett Research Institute, showed that the pasture was fairly normal in respect of

chemical composition. Since the duration of oestrus in Zebu animals on this pasture is also brief it seems probable that these animals naturally experience a much shorter heat period than do British breeds of cattle. To establish this point more fully a group of Zebu cows and heifers are being fed on a supplementary ration; it is too early yet to tell what the effect will be.

Effect of Nutrition on the length of the Interval between Calving and the recurrence of Oestrus in Cows.

It is known that in this country there is very often an abnormally long interval between calving and the recurrence of oestrus in cows. This experiment has been designed to determine the effect of feeding supplementary rations of concentrates and minerals upon the length of this interval.

Artificial Insemination.

Many advantages would accrue from the successful application of methods of artificial insemination to live stock (particularly cattle and sheep) in Kenya. It would benefit both the European farmer and the native. In neither case, however, can its application be divorced from a simultaneous improvement in the plane of nutrition. Large herds of grade cattle require large numbers of expensive pure-bred bulls and consequently it is very often impossible to use sufficiently good bulls. The application of artificial insemination would mean that a single bull could be used to serve a very much greater number of cows than is at present possible. Moreover, in dairy herds a bull is very often beginning to get past his best when his worth as determined by the progeny test is recognized. It is important that the best use should be made of such proved sires. The large flocks of woolled sheep in Kenya have been developed by crossing pure-bred or high-grade rams with native sheep. The use of artificial insemination would enable this process to be speeded up. It would enable better sires to be used over a much greater number of sheep.

Cattle.—Of the two pure-bred bulls on the Station one was ill and unfit for service; the other was of a very unruly temperament. This bull had been accustomed to run with the cows and would not serve a cow if she were tied up. Consequently, it was impossible to obtain sperm from him by means of the artificial vagina. The sperm collector was tried with no success. Massage of the ampullæ of the deferent ducts gave very poor specimens of sperm. With other bulls, however, the artificial vagina has been very successful and there

is no difficulty in collecting good specimens of sperm. All cows and heifers on the station are now being artificially inseminated as a routine practice.

Sheep.—Sperm is easily collected from rams by means of the artificial vagina. A flock of 202 high-grade Merino sheep are being artificially inseminated. Owing to the use of an unsuitable type of speculum, which in many cases did not properly expose the cervix, the results will be poorer than would have been the case had a suitable speculum been available. This difficulty has recently been overcome by the use of a different type of speculum, but the final results of the experiment are not yet available. As with the cattle the method is being employed as a routine for sheep. If successful it will permit of the disposal of 15 rams from the station flock. Formerly there were insufficient pure-bred Merino rams for service and a number of grade rams had to be used. A good pure-bred ram is being purchased in South Africa, and it should be possible to inseminate all the ewes on the farm with sperm from this ram.

Storage of Sperm.—The difficulty experienced in the early stages of the experiment in providing a suitable temperature for the storage of sperm has been overcome by the use of thermos flasks. There is no difficulty in maintaining a suitable temperature in these flasks, particularly if they are kept in a charcoal box.

Sterility.

Clinical investigations of bovine sterility are being made, and in many cases it is observed that heifers are equally as difficult as cows to get in calf. It is considered that interruption of pregnancy at an early stage may be, to some extent, responsible for the great irregularity of cycles in some cows. One case of foetal disintegration has recently come to notice. It appears likely that a certain proportion of cases of bovine sterility is due to foetal disorders.

It is considered that little further increase in our knowledge of the functional causes of sterility will result until more is known of the normal mechanism of reproduction in the domesticated animals. Any investigation with this aim must take into consideration not only the various internal factors involved in the control of the reproductive processes, but also the effect of environmental factors, and particularly that of nutrition. Finally, the effect of genetic make-up or breed characters must receive consideration.

With regard to reproduction in cattle, statistical analysis is being undertaken of breeding records in different parts of the country. In conjunction with observations on the oestrous cycle, it is proposed to continue the experiments on sex hormones begun some time ago. This work will be extended considerably, but at present it is held up until a suitable stock of rats and rabbits can be raised.

Equine Pregnancy Diagnosis.

An equine pregnancy diagnosis service has been started and is obtaining a fair amount of support, which will probably be increased when its usefulness becomes more generally known.

Investigations in Grassland Improvement.

The station has been selected as a site for experimental work by the officer in charge of Grassland Improvement as being representative of the comparatively dry areas of this Colony. Experimental work has included trials of pasture plants, and experimental renovation of denuded pastures and a manurial experiment. References to this work are made in the annual report of the Officer in charge of Grassland Improvement.

Experimental Station Farm.

After the long period of locusts and drought lasting for four years, grazing was practically non-existent on the Experimental Station and at the beginning of the period under review, even the sheep were unable to find sufficient keep. Consequently the sheep, steers and heifers were moved to the Quarantine Station at Naivasha.

The milking cows and young calves that were kept at the farm had to be fed a maintenance ration of concentrates and lucerne.

In spite of the grazing having been eaten down to the roots and the soil baked hard, after three weeks' rain which began in the second week of April, when 4.01 inches was registered at the homestead, the grazing had improved very materially. Thus it seems that the regenerative powers of Naivasha Star grass are very high. Although only 0.94 inches of rain were registered in May the milk yield figures for the months of March, April and May show how the grazing had improved :—

			No. of cows in milk			Average yield per cow per day
March	...	...	88	...	...	8.25 lb.
April	...	...	60	...	...	9.02 lb.
May	...	...	57	...	...	12.21 lb.

In March the cows were receiving concentrates and lucerne. The amount of lucerne was reduced by 75 per cent in April, while in May it was stopped altogether and the concentrates reduced by half.

From the beginning of April until the end of August the rains were rather spasmodic but for the last four months of the year they were very evenly spread out, with little drying wind or unduly hot sun. The grazing benefited accordingly, and was in better condition than it had been at any time during the previous five years.

It was distinctly noticeable that more rain fell on the Karati end of the farm than elsewhere, in fact rain often fell there when there was none at the homestead or on the lake farm.

The total rainfall registered during 1935 was 18.62 inches, and all the pastures seem to have completely recovered from the bad effects of the drought and locusts. As there was no cattle dip on the lake front and the area was badly infested with ticks, causing a small outbreak of east coast fever which prevented full use being made of this portion of the farm, a cattle dip and a well for water supply were put in during May, since when the dry cows, heifers and work oxen have been kept on this part of the farm. Ticks are still very prevalent; but by maintaining as many cattle there as is practicable, and by dipping and hand-dressing at five-day intervals, it is hoped that ticks will eventually be controlled.

The sheep were moved to the lake front during May, and although they were hand-dressed for ticks did not do as well as was expected and had to be brought up to the home farm.

During the latter part of December the milking cows and calves were moved to the lake front, the milking being done in movable bails.

In future it is intended to take advantage of this system, and to keep the cattle where the grazing is best. With only one permanent milking shed, it is often necessary for the milk cows to walk a considerable distance to grazing, with a consequent adverse effect on milk yields. At the same time, it will have to be noted whether the same efficiency can be maintained with temporary movable structures as with a solid permanent building.

Cattle.

The herd had been maintained for butterfat production, and for a time no bull calves were reared. It has, however,

been decided that bull calves will be reared in future, so that the farm will always have a number of steers for sale.

It is hoped to purchase a Friesian bull, so that those cows of Friesian type may be put to him, and the rest of the cows, which are of shorthorn or Ayreshire type or a cross of the two, may be mated to an Ayreshire bull.

As the home-bred heifers come into the herd it is intended that some of the original foundation cows shall be culled and sold.

The cows were tested for contagious abortion, and the 46 positive reactors were sent to the Veterinary Research Laboratory, Kabete, for experimental purposes.

Sheep.

The sheep are perhaps the biggest actual and potential asset of the farm. The original ewes were the pick of the ewe hogget flock of one of the biggest sheep breeders in the country and by the use of imported pure-bred rams there are now over 500 ewes on the farm and in addition 400 mixed hoggets and 340 lambs.

As it is the intention to breed rams for sale it is considered essential that a system of recording be adopted, so that particulars of the wool production of each sheep will be available, as well as its breeding record. In this way, after a few generations, any grade ram offered, although not pure-bred in the accepted sense of the word, will have been bred along pedigree lines from selected foundation ewes bearing the desirable characteristics of the breed, and by as good an imported ram as can be afforded.

A small flock of Black-head Persian sheep is kept and the ram progeny is sold to natives, and local farmers.

It has been the custom to lamb at different times of the year but it would seem that lambs dropped about October-November thrive best and until it is proved otherwise the main lambing will in future be confined to these months.

About 350 lambs were born from August to October and these have done very well.

From 997 sheep shorn in October roughly 7,500 lb. of wool was obtained and shipped to Europe for sale. This wool represented exactly nine months' growth after shearing.

All flocks were double-dipped in home-made lime-sulphur dip and the hoggets which were infected with scab were given a further dipping. All sheep were regularly dosed for wire-worm.

Pigs.

The herd consists of one pedigree pure-bred boar, five pedigree sows, and one non-pedigree sow, all of the Large White breed. Previously quite a number of young breeding stock were sold at prices showing a reasonable profit but this market has become over supplied and prices have dropped so that there is now little profit. All the pigs reared were disposed of as baconers. Again, the bacon market is over supplied, and although all the pigs were disposed of, it was only with difficulty. Under these circumstances the breeding of pigs will have to be watched carefully.

In an area of light rainfall where home-grown foods are not easily produced, the purchase of the necessary foods and the ruling price for bacon pigs leaves scarcely any profit to the producers. Although dairying and pig-production ought to go together it is only when baconers leave sufficient profit that the combination is sound, and at the moment it is perhaps wiser to feed the by-products of dairying to calves or at any rate not to over-produce pigs, which would only have the effect of further depressing the market.

General.

About ninety acres of maize were grown for silage and this was put into pits during August and September. A little more rain at the right time would have helped part of the maize considerably, as the soil seemed alkaline and had a tendency to dry up very quickly.

A few acres of Napier grass and two acres of lucerne were established on the lake front and have done very well.

A start was made with the erection of paddocks round the laboratory for experimental stock and later such buildings as are necessary to house these stock will be erected by native labour. Stone has already been cut and dressed and a post-mortem house built. Most of the original fences and buildings on the farm will have to be repaired and replaced and this is being done gradually.

Income.

Revenue was derived from the sale of butter-fat, steers, bacon pigs, wool and fat wethers, and a few sheep which were culled.

As the breeding stock increases more stock will be available for sale and the policy at present is not to sell any breeding stock, other than culls, until the farm is stocked up.

Returns actually received during the nine months are as under :—

					<i>Sh. cts.</i>	
Butter-fat	...	...	...	...	2,408	24
Cattle	...	...	...	...	1,305	00
Sheep	...	...	...	...	1,184	00
Pigs	...	...	...	...	3,289	30
Wool	...	...	...	...	3,461	85
Total	...	...	...	...	11,648	39

FINANCIAL STATEMENT

1ST APRIL, 1935

RECEIPTS								Amount	
								<i>Sh. cts.</i>	
Balance on Hand—							<i>Sh. cts.</i>		
Cash	..	..	..	..	..	..	65 34		
Bank	..	..	..	..	..	..	4,950 10		
								5,015	44
Live Stock	..	..	..	..	..	..	..	5,778	30
Butterfat	..	..	..	..	..	..	..	2,666	42
Wool	..	..	..	..	..	..	..	3,461	85
Sundries	..	..	..	..	..	..	..	358	95
Equine Pregnancy Diagnosis	..	..	..	..	..	..	..	22	50
Colonial Development Fund Grant	..	..	..	..	..	..	..	33,000	00
TOTAL RECEIPTS							..	<i>Sh.</i>	50,303 46
PAYMENTS									
Wages	..	..	..	..	..	..	..	4,019	03
Foodstuffs	..	..	..	..	..	..	..	5,433	32
Freight and Transport	..	..	..	..	..	..	..	1,747	72
Medicines and Instruments	..	..	..	..	..	..	..	588	09
Implements, Machinery, Buildings and Upkeep	..	..	..	..	..	..	..	4,017	72
Live Stock	..	..	..	..	..	..	..	46	11
Drugs and Apparatus	..	..	..	..	..	..	..	4,080	10
Sundries	..	..	..	..	..	..	..	1,991	21
Staff Salaries	..	..	..	..	..	..	..	7,152	50
Balances on Hand—							<i>Sh. cts.</i>		
Cash		..	..	..	..	..	159 01		
Bank	..	..	..	..	..	..	21,068 65		
								21,227	66
TOTAL PAYMENTS							..	<i>Sh.</i>	50,303 46

NOTE.—The Financial Statement does not include expenditure from the Deposit Account.

LIVE STOCK STATEMENT

Bulls	7
Grade Cows	69
Grade Heifers	92
Grade Calves	43
Lumbwa Cows	13
Lumbwa Heifers	14
Lumbwa Calves	17
Steers	5
Work Oxen	55
Pigs	60
Imported Merino Rams	11
Grade Merino Rams	21
Grade Merino Ewes	538
Grade Merino Hoggets	412
Grade Merino Lambs	336
Persian Rams	2
Persian Ewes	14
Persian Lambs	11
Ponies	3
Donkeys	4
TOTAL ..	1,727

RAINFALL RECORD

MONTH	1932	1933	1934	1935
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
January	0-00	0-05	0-00	0-17
February	0-00	0-00	0-00	1-19
March	1-70	0-67	0-69	0-74
April	1-69	1-47	1-57	4-01
May	3-90	1-64	3-29	0-94
June	1-15	1-02	0-88	3-70
July	0-00	0-95	1-01	0-00
August	2-81	2-64	1-15	0-43
September	1-40	1-28	0-81	2-17
October	1-70	1-56	0-31	2-40
November	0-80	0-38	1-47	1-18
December	1-90	1-38	0-60	1-69
TOTAL ..	17-05	13-04	11-78	18-62

R. DAUBNEY,

Chief Veterinary Research Officer.

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